Telrad DIGITAL

DIGITAL FAMILY OF SYSTEMS
Hardware and Configuration Manual

Telrad

76-110-0685/F Release SB6/DB6 Issue 1

110-0685/F
Release SB6/DB6
Issue1

DIGITAL
FAMILY OF SYSTEMS
Hardware Description Manual

Telrad Telecommunications Inc.
Woodbury, New York

110-0685/F
Release SB6/DB6
Issue 1

Telrad

Telrad Telecommunications Inc.
Woodbury, New York

NOTICE

The information in this manual refers to the Telrad DIGITAL family of telephone systems, including the DIGITAL KEY BX system, Release SB6 and the DIGITAL 400 system, Release DB6, March, 1998. Telrad, Ltd., reserves the right to make changes in the equipment described in this manual without notification. However, changes in the equipment do not necessarily render this manual invalid. Additional copies of this manual may be obtained from Telrad, Ltd. Reproduction of this manual or parts thereof, without written permission from Telrad, Ltd., is strictly prohibited.

The following are registered trademarks of the respective listed firms:

Trademark	Firm	Trademark	Firm
ACD I.Q.	Telrad Telecommunications, Inc.	Renata	Renata
AT&T	American Telephone and Telegraph Corp.	StarSet	Plantronics Corp.
Hayes	Hayes Microcomputer Products, Inc.	SuperConsole	Software Systems, Inc.
IBM	International Business Machines Corp.	Supra	Plantronics Corp.
IMAGEN	Telrad Telecommunications, Inc.	Telemagic	Remote Control International
MS-DOS	Microsoft Corp.	TelradLINK	Telrad Telecommunications, Inc.
MS WINDOWS	Microsoft Corp.	UL	Underwiters Laboratories, Inc.
Telrad Tracker Set	Telrad Communications, Inc		
Profile III	GN Netcom		

FCC Regulations
Warning

This equipment generates, uses and can radiate radio frequency energy and if not installed and used in accordance with the instruction manual, may cause interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference, in which case the user should contact the Telrad Field Service Department, at the telephone number listed below, to correct the interference problem. It has been tested and found to comply with the limits for a Class A computing device pursuant to Subpart J of Part 15 of the FCC Rules which are designed to provide reasonable protection against such interference when operated in a commercial environment.

Registration
The Telrad DIGITAL Family systems are registered with the FCC based upon compliance with part 68 of its rules. Connection of these systems to the nationwide telecommunications network is made through a standard network interface jack which you can order from your telephone company. Jacks for this type of customer-provided equipment will not be provided on party lines or coin lines.

Hearing Aid Compatibility
DIGITAL family telephones are Hearing Aid compatible, as defined in Section 68.316 of Part 68 FCC Rules.

Telephone Company Registration
It is usually not necessary to call the telephone company with information on the equipment before connecting the DIGITAL family system cabinet to the telephone network. But, if the telephone company should require this information, provide the following:

FCC Registration Number	- Key system	ARAISR-18430-KF-E
(on label affixed to cabinet)	- Multi-function (Hybrid Key/PBX) system	ARAISR-18427-MF-E
Ringer Equivalence Number		3.9B
USOC Jack:		DB15, RJ2EX, RJ2FX, RJSGX, RJ2HX, RJ21X, RJ48C
Service Order Code (SOC)	- for off premise extensions and all analog trunk cards except the DID card	9.OF
	- for DID cards	AS.2
	- for digital trunks	6.0P
Facility Interface Code (FIC):	- Central Office Ground-start trunk	02GS2
	- Central Office Loop-start trunk	02LS2
	- Direct Inward Dialing	02RV2-T
	- Off-premises extension	OL13C
	- Primary Rate Interface (PRI24)	04DU9-1SN
	- T1 (DIGITAL TRUNK) 04DU9-BN, 04DU9-DN. 04-DU9-1KN, 04DU9-1SN, 04-DU9-1ZN	
	- E&M (TIE TRUNK INTERFACE -- 2-wire)	
	- E&M (TIE TRUNK INTERFACE -- 4-wire)	

Rights of the Telephone Company
If the system is determined to be causing harm to the telephone network, the telephone company may discontinue your service temporarily. If possible, the telephone company will notify you as soon as possible. You will be given the opportunity to correct the situation and you will be informed of your right to file a complaint to the FCC. Your telephone company may make changes in its facilities, equipment, operations, or procedures that could affect the proper functioning of your system. If it does this, you will be notified in advance to give you the opportunity to maintain uninterrupted telephone service.
In the event of an equipment malfunction, all repairs will be performed by Telrad Telecommunications, Inc., or by one of its authorized dealers.

Address of repair facility in USA
Telrad Service Center, 135 Crossways Park Drive, Woodbury, NY 11797. Phone: 1-516-921-8300 or 1-800-645-1350.

THIS PAGE INTENTIONALLY LEFT BLANK

Section 1
INTRODUCTION

1. 1 GENERAL

This section provides introductory information about the manual and a general overview of the DIGITAL family of telephone systems. These systems, the DIGITAL KEY BX (a 128 port system) and the DIGITAL 400 (a 384 port system), are also referred to as "DIGITAL systems".

1. 2 SCOPE OF MANUAL

1. 2. 1 Purpose

This manual serves as a reference for the DIGITAL systems. It provides a functional and physical description of its equipment.

The manual is intended for DIGITAL system customers and distributors, as well as for personnel involved in DIGITAL system installation, servicing, and customer training.

1. 2. 2 Contents

Section 1	Includes a general explanation of the contents of the manual and information on applicable documents.
Section 2	Provides a functional description of the systems and describes the systems' installation, administration and maintenance.

Section 3	Describes common system equipment including the MPD card, Main Motherboard and Small Auxiliary Motherboard (SAX).
Section 4	Describes the peripheral cards used in the systems.
Section 5	Details the power supply requirements, including external connectors and switches.
Section 6	Includes description of the proprietary telephone sets and the terminal equipment option cards.
Section 7	Details system wiring, including the MDF connection, and printer, PC, and external modem connections.
Section 8	Describes the configuration of the telephone sets.
Section 9	Includes functional description of external equipment and hardware requirements.
Appendix A	Details system provisioning.
Appendix B	Details system specifications.

1. 3 SYSTEM DEFINITION

1. 3. 1 DIGITAL KEY BX system

The DIGITAL KEY BX is a highly flexible, digital, integrated voice/data business telecommunications system providing up to 128 ports with a maximum of 48 outside lines (with up to 80 extensions) or 96 extensions (with up to 32 outside lines). In addition, the system accommodates up to eight 36-button Add-on units.

1. 3. 2 DIGITAL 400 system

The DIGITAL 400 is a highly flexible, digital, integrated voice/data business telecommunications system providing up to 384 ports with a maximum of 144 outside lines (with up to 240 extensions) or 254 extensions (with up to 130 outside lines). Its many features can be tailored to your exact specifications and can be modified at any time to match your organization's changing needs.

1. 3. 3 System features

The DIGITAL systems can be installed in any office. They are quiet, operate under normal office environmental conditions and can be located almost anywhere within the customer's premises.

The DIGITAL systems feature:

- Automatic Call Distribution (ACD, and ACD I.Q. options;
- Ability to connect Single Line Telephones (SLTs) and compatible equipment;
- Handsfree answerback speakerphone enabling offhook voice announce option;
- Modular and flexible design;
- Multisystem networking capability;
- Optional programming of extensions to utilize the Multiple Station Appearance (MSA) approach;
- Port oriented architecture;
- PRI24/PRI30 and BRI digital Integrated Services Digital Network (ISDN) outside line compatibility;
- System cabinet cards (except the MPD card) common to both systems;
- System expansion using additional cabinets;
- T1/E1 digital outside line compatibility

1. 3. 4 Technology

DIGITAL systems combine the ease of use of a key system with the sophistication of a Private Branch Exchange (PBX). The DIGITAL systems make full use of advanced technology including:

- Computer Telephone Integration, including Circuit switched data (CSD), Circuit switched voice (CSV),
- Telephony Application Programming Interface (TAPI);
- Telephony Services Application Programming Interface (TSAPI);
- Digital communications and signaling;
- Distributed control using microprocessors located in both the proprietary telephone sets and in each system card;
- Electronic component miniaturization by use of Surface Mount Technology (SMT);
- End-to-end digital, including digital telephone sets;
- Integrated voice and data using an S bus, with 2B+D architecture, to enable connection of two proprietary telephone sets on one line;
- Voice activated dialing.

1. 3. 5 External devices

The following industry-standard, external devices can be connected to the DIGITAL systems:

- Announcers;
- Answering machines;
- Background music source;
- Bells;
- Cordless/wireless telephones;

- Door locking and opening units;
- Equipment activating relays, sensors and switches;
- Fax machines;
- Headsets;
- ISDN modems;
- Modems;
- Music on hold source;
- Paging devices;
- Personal computers;
- Printers;
- Video conferencing devices;
- Voice mail systems.

1. 4 APPLICABLE DOCUMENTATION

This manual is one of a series on the DIGITAL systems, including the following documents. Except where specifically identified as being applicable to either the DIGITAL KEY BX system or the DIGITAL 400 system, the documents listed below are applicable to ***both.***

	Document	Catalog Number
System manuals	***Feature Description manual*** Provides a description of the DIGITAL system's features, and details the criteria for its configuration.	76-110-0690/F
	Operating instructions Details the operation of the many system and user features.	76-110-0165/F
	Administration manual Contains a detailed explanation of the programmable features and parameters and a guide to the programming of each of them on a personal computer.	76-110-0175/F
	Administration forms Contains a copy of each of the programming forms.	76-110-0405/F
	Installation manual Contains a detailed explanation of the hardware installation and functional verifications.	76-110-0410/F
	Maintenance manual Contains a detailed testing and maintenance guide.	76-110-0170/E
ACD documentation	***ACD agent user guide***	76-110-0425/D
	ACD system manual	76-110-0430/D

	ACD I.Q. user manual	76-110-0675/F
	ACD supervisor user guide	76-110-0440/D
	ACD I.Q. Wallboard Installation and Programming guide	76-110-0585/F
Data options	***TAPI/TelradLINK Installation and Programming Manual***	79-123-0410/E
	Universal data card manual	79-125-0410/F
Option documentation	***Electronic Business Card Installation and Programming manual (with IMAGEN only)***	76-110-0380/F
System user documentation	***Executive set with expanded display user guide***	79-100-0009/F
	Executive set and Executive set with display user guide	79-100-0006/F
	Speakerphone set and Display Speakerphone set user guide	79-500-0006/F
	4 Button set and 16 Button set user guide	79-400-0006/F
	Single Line Telephone user guide	76-110-1706/F
	Analog telephone set user guide	73-510-3000/F
	Attendant console user guide	79-120-0006/F
	Executive set with expanded display quick reference guide	79-100-0021/F
	Executive set and Executive set with display quick reference guide	79-100-0020/F
	Speakerphone set and Display Speakerphone set quick reference guide	79-500-0009/F
	4 Button set and 16 Button set quick reference guide	79-400-0009/F
	Single Line Telephone quick reference guide	79-110-0007/F
Telrad Tracker Set	***User Guide***	79-070-0009/6
	Quick Reference Guide	79-070-0008/2
	Configuration Addendum	79-070-0007/9
Package documentation	***Data card installation for Executive stations***	79-020-0306/D
	Data card installation for standard stations	76-020-0406/D
	Option module installation	76-110-0545/D
Technical addenda	***Upgrade manual***	76-110-0455/F

IMAGEN	***IMAGEN Integrated Voice Mail Application Generator User manual***	76-110-0570/H
	IMAGEN Integrated multi-application generator System manual	83-130-8050/I
	Integrated SMDR Call accounting manual	83-110-0270/H
	IMAGEN Executive set with expanded display user guide	76-110-0190/H
	IMAGEN digital telephone set, analog telephone set and SLT user guide	76-110-0205/H
	IMAGEN quick reference guide	76-110-0620/H

1. 5 THE CURRENT ISSUE

This issue, SB6/DB6, replaces the previous issue, SB5/DB5. The System Description of the previous issueincluded both Hardware and Feature Descriptions. In this release, Hardware and Features are discussed in separate documents.

All release revisions and enhancements apply to both the DIGITAL KEY BX system and the DIGITAL 400 system, where not specified otherwise.

Differences between the various aspects of the two systems, where applicable, are discussed in the pertinent sections of this manual. Where no differences are mentioned, assume that there are none.

1. 6 CONVENTIONS

1. 6. 1 Terminology conventions and abbreviations

This manual refers to both the DIGITAL KEY BX and DIGITAL 400 systems. These two systems are referred to in this manual as the DIGITAL systems or the DIGITAL family of systems depending on the context.

The DIGITAL family of systems supports three types of telephones:

- Telrad digital telephones:
  Referred to in this manual as digital telephone sets or DIGITAL telephone sets;

- Telrad analog key electronic telephones:
  Referred to in this manual as analog key telephone sets;
- Single line analog telephones:
  Referred to in this manual as single line telephones or SLTs.

Depending on the type and size of your DIGITAL system, one of the following MPD cards is used:

- **MPD386**
  This is the name of the MPD card used with all DIGITAL KEY BX (128 port) systems. This MPD card can also be used with one-cabinet DIGITAL 400 systems (up to 128 ports).
- **MPD S400**
  This is the name printed on the MPD card used with all DIGITAL 400 systems. This MPD card must be used with any DIGITAL 400 system having more than 128 ports and with all multiple cabinet DIGITAL 400 systems.

The following abbreviations are used in this manual:

- ACD Automatic Call Distribution;
- ACD I.Q. Automatic Call Distribution Information Query;
- AWG American Wire Gauge;
- BBU Battery Backup Unit;
- BERT Bit Error Rate;
- BRS ISDN Basic Rate Interface internal line card (station);
- BRT ISDN Basic Rate Interface internal line card (four ports)
- BHT ISDN Basic Rate Interface internal line card (two ports);
- CHL Analog loop-start outside line card (four ports);
- CO Central Office (public exchange);
- COG Analog ground-start outside line card (eight port);
- COL Analog loop-start outside line card (eight port);
- CSU Channel Service Unit;
- CSV Circuit Switched Voice;
- DCD Data Carrier Detector;
- DID Direct Inward Dialing;
- DIP Dual In-line Package;
- DTE Data Terminal Equipment;
- EHD Digital telephone set card with four ports;
- EHU Error Handling Unit;
- ELA Analog telephone set card with eight ports;
- ELD Digital telephone set card with eight ports;
- EMD E and M tie card (networking);
- EMI Electromagnetic Interference;
- FRRN Free running;

- HONS Eight port card for on-site SLTs
- IMAGEN Integrated Multi-Application Generator;
- ISDN Integrated Services Digital Network;
- LED Light Emitting Diode;
- MDF Main Distribution Frame
- MFC Multifreqency Compeller;
- MPD Main Processing card;
- OCD Option card;
- ONS 16 port card for on-site SLTs;
- OPX Off Premise Extension;
- PCM-30 30 channel E1 digital outside line card;
- PRI ISDN Primary Rate Interface outside line card;
- PRIM Primary;
- RFI Radio Frequency Interference;
- SAX Small Auxiliary motherboard;
- SEC Secondary;
- SHD Four port SLT card with OPX capabilities;
- SLD Eight port SLT card with OPX and message lamp capabilities;
- SLT Single Line Telephone;
- T1 24 channel digital outside line card**.**

1. 6. 2 Assumptions

It is assumed that those using this manual have a basic knowledge of telephony, the use of a personal computer and the Telrad DIGITAL telephone systems.

Section 2
GENERAL DESCRIPTION

2. 1 GENERAL

This section contains the functional description of the system, as well as a brief explanation of the system's installation, administration, and maintenance.

2. 2 FUNCTIONAL DESCRIPTION

2. 2. 1 Control

The System control functions are located on the MPD card. The MPD's Central Processing Unit (CPU), a 16 bit microprocessor, is responsible for the calculations and any decision making involved in call processing. The CPU is also responsible for the statistical allocation of communication channels (See Figure 3-3).

The MPD uses the internal LAN, located on the motherboard, for signal transmission. Control signals are transmitted to other system cards, using packet switching at 1.5 megabits per second, according to the CSMA/CD protocol.

Each system card, including the MPD, contains a16 bit microcontroller which controls the hardware components on the card and handles communications.

2. 2. 2 Signaling

Data communication between terminal equipment and the system cabinet is carried out on the D channel of the S bus. This provides a channel for signaling, dialing, etc., operating at 16 Kb per second. The CSMA/CD packet switching protocol is used.

2. 2. 3 Call switching

Call switching is carried out by the switching matrix, located on the MPD card. The switching matrix is controlled by the card's CPU and determines the time slots used to switch between the system's PCM highways. There are eight PCM highways in the DIGITAL KEY BX and 16 PCM highways in the DIGITAL 400. Each PCM highway has 32 time slots, one for tones, and the others for speech. Calls are routed on the B channels of the S bus at 64Kb per second. Depending on the customer's requirements, either the μ-law PCM method (North American standard) or the A-law method (European standard) of analog-digital conversion is used. The system is non-blocking, i.e., all outside lines and extensions can be used simultaneously.

2. 2. 4 Call processing

All decisions regarding call processing are carried out by the MPD's CPU. The CPU accepts input from other cards and terminal equipment and makes output decisions based on the following:

- Static databases that reflect the system configuration as defined in system administration (refer to the DIGITAL systems Administration manual);
- Dynamic databases that reflect the immediate status of the system as reported by both peripheral cards and terminal equipment.

The CPU's decisions result in signal outputs to the peripheral cards, the dynamic database, the switching matrix and any auxiliary resources (DTMF receivers, tone generators, etc.) with which the system is provisioned.

2. 3 INSTALLATION

The installation of a DIGITAL system comprises several stages: planning, site preparation, physical installation and system verification.

The system includes up to three modular cabinets, connected by cables. Each cabinet includes its own power supply and slots for DIGITAL printed circuit cards. A basic description of the system cabinet for each of the DIGITAL systems is presented in Section 3. 2.

A single, 25-pair, cable connects each card to the Main Distribution Frame (MDF). Two- or three-pair crossconnect or two-pair covered wire (24 AWG) cables, or three-pair crossconnect or three-pair covered wire for analog sets, connect the MDF to junction boxes. The ISDN passive bus enables two telephone sets to be connected to one port on each ELD or EHD card. Outside lines from the Central Office are wired directly to the MDF.

For ease of identification, each hardware item, such as the cabinets, option modules, etc., comes in its own container together with an explanatory note detailing installation procedures.

The considerations for planning the location of the cabinets and telephone sets and comprehensive installation instructions and procedures are detailed in the DIGITAL Installation manual.

2. 4 ADMINISTRATION

DIGITAL systems are configured by means of a personal computer (IBM PC, 286, 386, 486 Pentium or compatible) with a hard disk. The software is installed onto the computer using a proprietary installation program. The configuration program is menu-driven, user friendly and self-explanatory.

The DIGITAL systems are configured in three stages:

- The configuration is planned on administration forms;
- This data is entered into the configuration computer;
- The configuration data is restored (downloaded) to the DIGITAL system.

The configuration program operates in one of two modes - offline and online:

- In offline mode, there is no connection between the PC and the DIGITAL system. A customer configuration file is prepared and stored on disk. This file is transferred to the system at a later time.
- In the online mode, the PC is connected directly to the system, either via modem, or locally via a cable connected to the MPD card. A new configuration can be

restored to the system, and the current configuration can be backed up (uploaded) to the PC, for backup or modification. As soon as a restore is complete, the new configuration is operational. This makes updating and modifying an existing configuration both simple and time saving. No visit to the customer site is necessary.

Most of these procedures are performed without interruption to system operation.

Comprehensive administration instructions and procedures are included in the DIGITAL Administration manual. A separate Administration Forms manual includes all the programming forms.

2. 5 MAINTENANCE

2. 5. 1 General

Corrective maintenance consists of fault detection, isolation and bad or faulty unit replacement. No preventative maintenance is required.

Basic instruction in system maintenance is provided within a very short time. Comprehensive maintenance information is contained in the DIGITAL Maintenance manual.

2. 5. 2 Fault detection

Fault detection equipment is built in. Upon detection of a fault, the system generates a warning which is defined either as a major alarm, a minor alarm or a diagnostic alarm, depending on the severity of the fault. All alarms and messages are stored in the system Error Handling Unit (EHU). These messages are examined and evaluated later by maintenance personnel.

The warnings can be sent at a later time to the printer used for Station Message Detail Recording, or to a computer connected to the system. In addition, major and minor alarms are displayed at the attendant console.

The system also generates diagnostic messages which provide information on the system's status. The alarm message alone often provides the necessary information to isolate the faulty unit.

If a fault liable to disrupt system operation is detected, the system can dial the Service Center automatically via an external modem and transmit the most recently generated alarms. This occurs when in remote modem mode.

By utilizing the maintenance information feature, you can display a series of current data on the Administration PC. This includes information regarding each port on each card of each shelf in the system cabinet, including its in-service or out-of-service status.

2. 5. 3 LEDs

A further aid to maintenance is provided by LED indicators on various system cards. For example, indicators are located on Central Office COG, COL and CHL outside line cards for each outside line circuit. The LEDs indicate whether circuits on the card are operating correctly.

2. 5. 4 Maintenance testing

In the DIGITAL 400 system only, a series of three maintenance testing and information approaches are used. These allow for flexibility in planning and carrying out comprehensive surveillance and review of the status and operation of the system and its various components. These approaches can be used individually or in combination to suit system needs. They include the following:

Online component testing A specific component or system resource to be tested can be selected from the appropriate menu. The test results are displayed immediately on the screen of the administration PC.

Examples of tests on system cards are channel loop-back tests on line cards and outside line cards and local loop-back and remote loop-back tests on T1/E1 cards. An example of system resource testing is a DTMF receiver test.

Utilizing a softkey on the Administration PC, individual ports currently in service can be taken out of service, and ports that have been declared out of service can be put back into service.

Daily administration testing Daily system testing, including a range of elements defined in the configuration program, can be scheduled for output at a fixed hour each day. Daily automatic testing can be used to check all system ports and detect defective units out of service. A variety of other test data can be derived from daily test reports, including the following:

- channel loop-back failures;
- outside line test failures;
- outside line status;
- DTMF receiver failures;
- DTMF receiver status.

Maintenance information The Maintenance information utility can be used to review operational status and parameters of each card in the system, as well as each of that card's components. A detailed list provided for a card includes the following:

- the DN for each line;
- outside line or module port;
- the port number and type;
- the corresponding highway, time slot, bus and terminal number (where applicable);
- in service or out of service status.

2. 5. 5 Technician set

An Executive set with expanded display with a data card can be utilized by authorized personnel as a Technician set. When suitably activated, the Technician set can simulate any type of telephone set in the system, in any configuration type. The set is a vital tool either in installation, debugging or revision of set and configuration assignments.

2. 5. 6 System reset

Many maintenance functions, such as system reset, can be initiated from a remote location so the fault can be corrected without a technician visiting the customer site.

Two types of system resets are available from the PC:

- Programmer reset -- resets the entire system while maintaining the present configuration;
- Default reset -- resets the entire system, by performing default download, while reverting to the default configuration.

The default reset can also be initiated manually using the MPD card reset buttons.

2. 5. 7 Corrective action

Corrective action involves the replacement of the faulty equipment (telephone set, card, power supply, etc.). In most cases, this can be performed without disruption to system operation.

Section 3
COMMON SYSTEM EQUIPMENT

3. 1 GENERAL

This section provides a brief functional description of the system hardware components which are shared by all of the users, including block diagrams of major units.

3. 2 SYSTEM CABINET

The system cabinets for each of theDIGITAL systems are shown as follows:

- Figure 3-1: for the DIGITAL KEY BX system;
- Figure 3-2: for the DIGITAL 400 system.

3. 2. 1 DIGITAL KEY BX system

The system cabinet contains the power supply, the motherboard and the system cards which fit into card slots in the housing and connect to the motherboard.

The DIGITAL 400 system can consist of a maximum of three cabinets. Each cabinet contains six card slots. The MPD card must be placed in the:

- first slot of the cabinet, in a single cabinet configuration;
- first slot of the first cabinet, in a multicabinet configuration.

All other card slots are universal, i.e., any card can be placed in any slot.

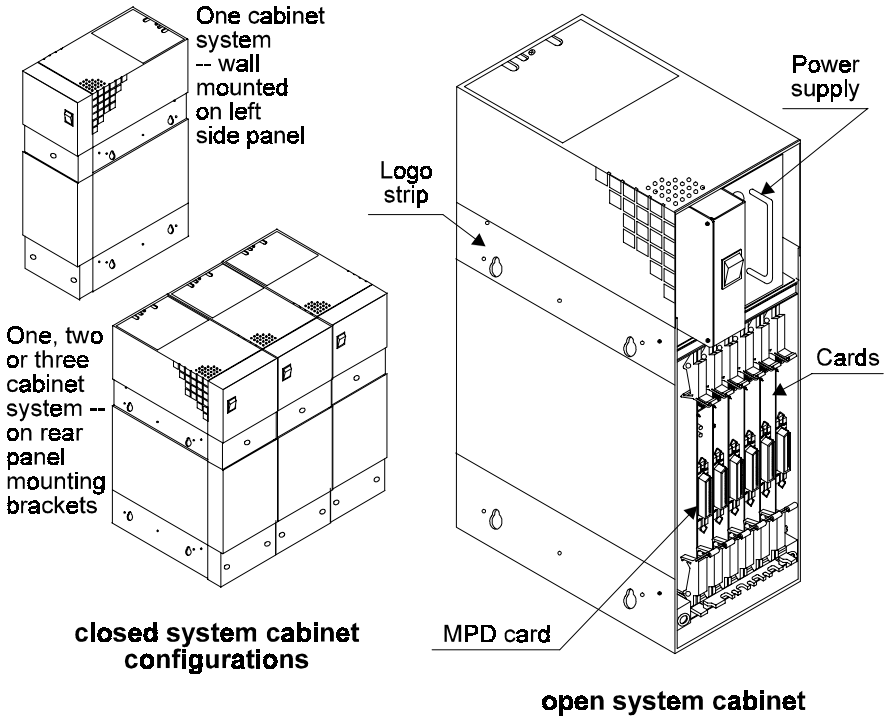


Figure 3-1 DIGITAL KEY BX system cabinet

3. 2. 2 DIGITAL 400 system

The system cabinet contains the power supply, the main motherboard, the Small auxiliary motherboard (optional) in one cabinet systems, and the system cards which fit into slots in the housing and connect to the motherboard.

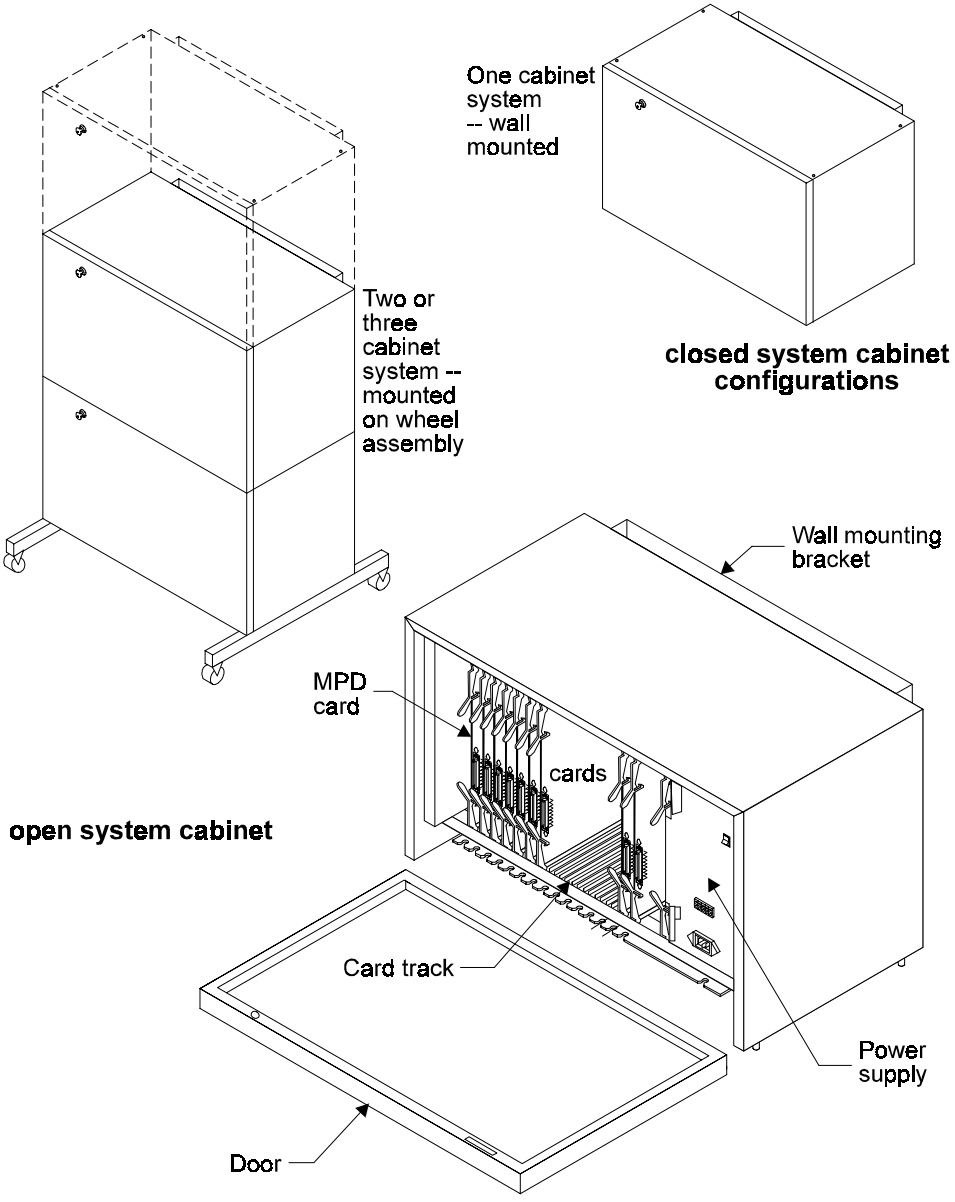


Figure 3-2 DIGITAL 400 system cabinet

The DIGITAL 400 system can consist of a maximum of three cabinets. Each cabinet contains 15 card slots. The MPD card must always be placed in the first slot from the left of the:

- single cabinet -- in a one cabinet, configuration;
- upper cabinet -- in a two cabinet configuration;

- middle cabinet -- in a three cabinet configuration.

All other slots are universal; any card can be placed in any slot. An installation, using a single DIGITAL 400 system cabinet, can be configured as a DIGITAL KEY BX system with up to 128 ports.

3. 3 SYSTEM CABINET MOUNTING OPTIONS

3. 3. 1 The DIGITAL KEY BX system

The DIGITAL KEY BX cabinet is constructed for easy mounting on a wall. The one cabinet configuration can be mounted with either:

- The rear panel against the wall;
- One of the side panels against the wall.

Two or three cabinet configurations are mounted with the cabinet rear panels against the wall. To rear mount either a one, two or three cabinet system, the DIGITAL KEY BX wall mounting kit is required.

3. 3. 2 The DIGITAL 400 system

The DIGITAL 400 cabinet is constructed for easy mounting, in one of the following ways:

A single cabinet can be wall mounted, with the rear panel against the wall, as shown on the right side of Figure 3-2, above;

- One cabinet, two cabinet or three cabinet configurations can be stack mounted on a wheel assembly, as shown on the left side of Figure 3-2 above.

For detailed mounting instructions, refer to theDIGITAL family of systems Installation manual.

3. 4 LINKING SYSTEM CABINETS

3. 4. 1 The DIGITAL KEY BX system

Up to three system cabinets can be linked together, enabling modular growth.

Only the first cabinet's power supply is connected to the 110 V input power. Each of the other cabinets' power supply units draw their power from the adjacent cabinet. All but the first power supply unit are permanently switched on.

The motherboards of each cabinet, in a multicabinet system, are linked in series by means of flat cables which carry the internal LAN and PCM highways.

3. 4. 2 The DIGITAL 400 system

Up to three system cabinets can be linked together enabling modular growth. Although they appear to be externally identical, the top and middle cabinets in two cabinet and three cabinet systems have no bottom panel, to facilitate required wiring, cabling, and air circulation.

Each cabinet's power supply is connected to the 110 V input power:

- via a cable, directly to a dedicated wall outlet, for a wall mounted system;
- via a cable from each cabinet's power supply, plugged into an outlet mounted on the wheel assembly;
- via a single cable from the wheel assembly composite outlet to a dedicated wall outlet.

In a multicabinet system, the motherboards of the various cabinets are linked in series by means of flat cables which carry the internal LAN and PCM highways. An additional small SAX is installed in the upper cabinet of a two cabinet system, and in the middle cabinet of a three cabinet system. The SAX is installed in the same cabinet in which the MPD card for the respective system is inserted.

For more information, refer to the DIGITAL family of systems Installation manual.

3. 5 MAIN PROCESSING (MPD) CARD

The MPD card is the system's main control unit. It supervises and controls all the peripheral cards in the system and provides all the system's signaling and switching capabilities. The system software program and configuration data reside in a plug-in memory cartridge.

Only one MPD card is used per system.

Two MPD card models are available, depending on the system size:

MPD386

- is used in all DIGITAL KEY BX systems;
- can be used in a DIGITAL 400 system configuration using a single cabinet (containing up to 128 ports). If you expand the configuration, this model has to be replaced.
- contains four analog Central Office Outside line (loop start) interface ports, enabling the connection of up to four outside lines. This allows very small installations to operate without any outside line card.
- includes an auxiliary services unit, with a DTMF receiver and two analog audio channels with general purpose relays, which support such features as music on hold, background music, door unit, and external page.

MPD-S400

- must be used in all DIGITAL 400 multicabinet system configurations containing up to 384 ports;
- supports 384 ports, additional Multi-Directory Number (MDN) groups, as well as other expanded capabilities.

3. 6 FUNCTIONAL UNITS

The MPD can be divided into the following functional units, shown schematically in Figure 3-3:

- Central processing unit (CPU);
- Memory cartridge;
- Microcontroller unit;
- Switching matrix;
- 386 processor on the MPD386; 286 processor on the MPD-S400 card
- Communication interface;
- Analog CO interface unit (on the MPD386 only);
- Auxiliary unit;
- Services unit;
- RS-232C interfaces;
- Mailbox;
- Digital Phase Locked Loop (DPLL) synchronization unit (on the MPD-S400 card only);

However, a DPLL synchronization daughterboard can be mounted on the MPD386, for Digital Key BX systems that have T1 or E1(PCM 30 or E1-MFC-R2), BRT, BHT, PRI24, or PRI30 cards.

.

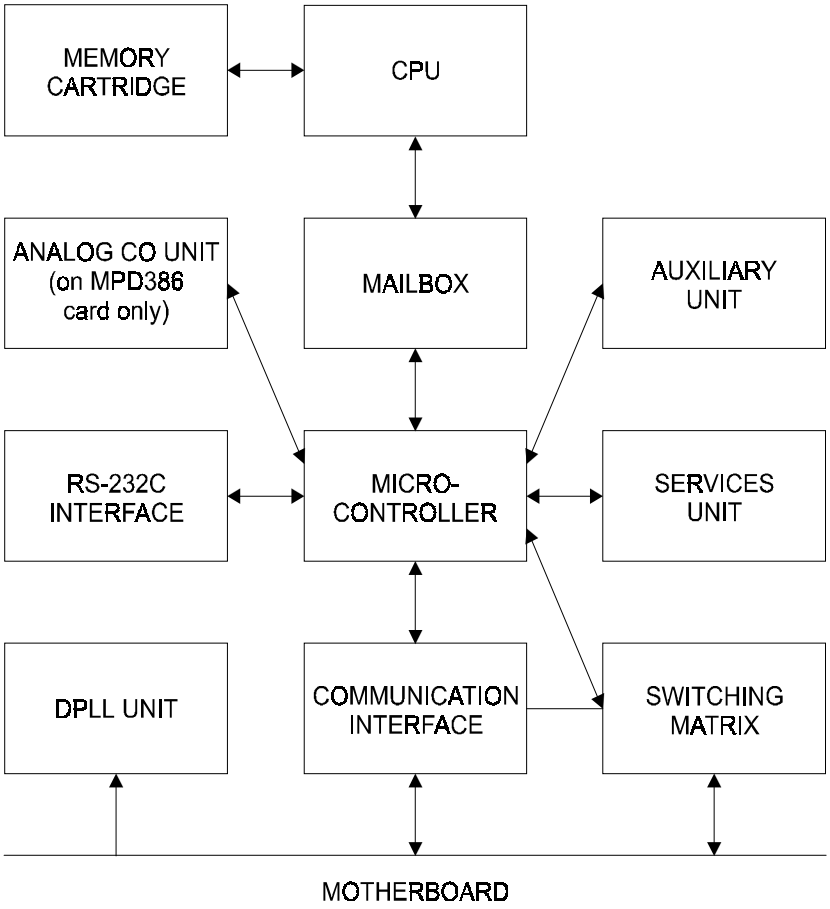


Figure 3-3 MPD card major subsystems

3. 6. 1 Central processing unit (CPU)

The central processing unit is based on a 16 bit microprocessor. The CPU makes the calculations and decisions involved in call processing, such as call switching on the switching matrix. The CPU integrates and conducts the system data processing.

The CPU's primary responsibilities are as follows:

- Call switching via the switching matrix;
- B-channel management;
- Call signaling, e.g., data transfer between the cards and the telephone sets in the system via the D-channel;
- Implementation and data processing of the configuration created using the configuration program;
- System features implementation, e.g., (Least Call Routing) LCR and hunt groups.

3. 6. 2 Memory cartridges

Every MPD card requires a memory cartridge. There are four types of memory cartridges available as shown in Table 3-1. The type of memory cartridge that you need for your system depends on the style of the MPD card and whether or not your system supports Automatic Call Distribution (ACD).

Table 3-1 Memory cartridge models

MPD type	Memory cartridge	
MPD386	Basic 128 port model	ACD 128 port model
MPD-S400	Basic 384 port model	ACD 384 port model

The MPD386 memory cartridge has up to 3 Mb of Flash Read only memory (ROM) and up to 2 Mb of memory.

The MPD-S400 memory cartridge has up to 1.5 Mb of Flash Read only memory (ROM) and up to 1.5 Mb of memory.

Both systems use Static Random Access Memory (SRAM) for system configuration data. The memory cartridges also include an internal "mailbox" which is used in communicating with the rest of the system.

The memory cartridges have a replaceable lithium battery with a three year average life expectancy. The plastic memory cartridge is sealed, and has a sliding door for easy access to the battery. See the Installation and Maintenance manuals for details of the battery replacement procedure.

3. 6. 3 Microcontroller unit

The microcontroller, an eight bit Universal Communications Controller (UCC), mediates between the CPU, the rest of the MPD card's functional units and the rest of the system.

The UCC does the following:

- Implements CPU decisions regarding call switching on the switching matrix;
- Controls the auxiliary unit;
- Controls the service unit;
- Mediates between the CPU and the Analog Central Office unit (on the MPD386 only);
- Channels information between the card's RS-232C interface and the CPU;
- Interprets CPU messages for other cards, or terminal

equipment, for dispatch via the communications unit;
- Handles all communication requirements.

3. 6. 4 Switching matrix

The switching matrix handles all the system's switching requirements, under the control of the CPU. The matrix also contains the conference call circuits. A control unit governs the conference call circuits operation by switching the PCM highways to connect to the conference circuit.

3. 6. 5 Communications interface

The primary purpose of the communication unit is to mediate between the system outside the MPD card and the Control unit, via the motherboard. Communication is by the internal LAN, for signal transmission at 1.5 MB per second according to a proprietary protocol. This protocol specifies communication standards.

3. 6. 6 Analog Central Office (ACO) Interface unit

The MPD386 contains an Analog Central Office (ACO) unit for connection of four loop start outside lines from a CO. The unit is identical in function to the COL card, but can handle only four outside lines.

The ACO unit is controlled by the Peripheral Board Controller (PBC) of the communications unit.

3. 6. 7 Auxiliary unit

The Auxiliary unit contains the following system internal utilities:

- Real time clock (RTC). This provides the time displays on the DIGITAL system telephone sets;
- Pulse Coded Modulation (PCM) clock. This provides the clock and synchronous impulses for the system and mediates between the system and the CO;
- PCM call progress tone generator. This generates ringback tone, dial tone, busy tone, reorder (error) tone, etc. These tones are sent to the telephone sets through the tone highway;
- Duel Tone Multi-Frequency (DTMF) generator. This creates 16 tones for DTMF dialing on outside lines.

3. 6. 8 Services unit

The following resources are provided by the auxiliary services unit:

- On the MPD386;
  - One, half duplex, audio channel which can be used for Background Music (BGM) and music on hold (MOH) in one direction and external page in another.
  - An external music on hold (MOH) and Background Music (BGM) source can be connected via the RCA jack provided;.
  - One relay (electromechanical switch) is used for door unit operation, external bells etc. It can activate a different external page zone.
  - One relay. Each relay can activate a different external page zone.
  - A DTMF receiver.

- On the MPD-S400 card
  - One audio channel can be used for BGM.
  - One audio channel can be used for MOH. An internal MOH chip provides ten melodies, played serially for MOH, or an external MOH source can be connected
  - A DTMF receiver.

3. 6. 9 Jumpers (On the MPD386)

Ground definition jumper An RS-232 ground definition jumper is located on the MPD386 (as on all CO cards and OCD cards). The jumper, set by the technician in the field, determines whether an attached device will be signal ground ("natural state") or frame ground. This is important in reducing electromagnetic interference "noise".

3. 6. 10 Digital Phase Locked Loop (DPLL) synchronization unit

The DPLL synchronization unit consists of the DPLL Frame Reference switch. This connects the reference signal and the DPLL Clock generator. The clock generator ensures that the data is transmitted in a synchronized manner from the DPLL reference clock on the MPD card. The time base of the generator is a crystal oscillator with an accuracy rate of between 10^{-5} and 10^{-6}, according to the Stratum 4 standard. When the system is connected to a Central Office, the system clock, controlled by the timing unit, is synchronized with an external clock in the Central Office.

This unit is an integral part of the model MPD-S400 card. However, a special DPLL daughterboard cartridge must be connected to the MPD386, if used in a configuration with a T1, E1 (PCM 30 OR E1-MFC-R2), BRT, BHT, PRI24 or PRI30 card.

3. 7 MPD CARD EXTERNAL CONNECTIONS

A label strip gives the names of the external connectors and buttons. It appears on the first system cabinet, next to the MPD card. (See Figure 3-4.)

A 50-pin connector connects the MPD386 to the MDF. A single 64-pin connector connects the MPD386 to the motherboard.

Two 64-pin connectors connect the model MPD-S400 to the motherboard.

A Music On Hold RCA jack is provided for connection of an external MOH source.

A Background Music RCA jack is provided for connection of an external BGM source.

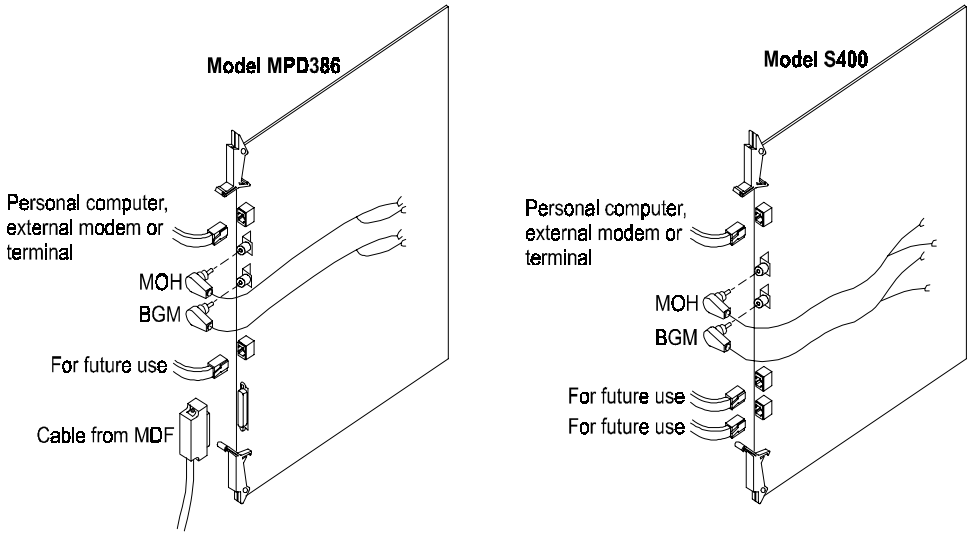


Figure 3-4 MPD card external connections

There is an RS-232C port on both the MPD386 and MPD-S400. This allows connection to either a personal computer for system administration and maintenance, a terminal, an external modem or a printer.

One additional RS-232C port is provided for future use on the Model MPD386. Two additional RS-232C ports are provided for future use on the Model MPD-S400.

3. 8 MAIN MOTHERBOARD

The motherboard is fixed permanently at the rear of the cabinet and provides all the connections required among the power supply, system cards, and other motherboards in multicabinet configurations. The motherboard has a 64 pin male connector for each of the system cards as follows:

- six cards for DIGITAL KEY BX;
- 15 cards forDIGITAL 400.

You can use flat cable connectors to link the motherboard to other motherboards located in adjoining cabinets.

In the DIGITAL KEY BX system cabinet, a cable terminating in a 12-pin female connector connects the motherboard to the power supply.

In the DIGITAL 400 system cabinet, the power supply is inserted into the system cabinet. A connector on the rear of the power supply plugs into its counterpart connector on the main motherboard.

The motherboard provides channels for the following:

- Supply voltages, connected in parallel to all cards;
- Signaling and data on the internal global serial communication LAN ("G"-bus). The "G"-bus functions both as a PCM highway and as the LAN between the cards;
- Eight PCM highways for DIGITAL KEY BX and eight PCM highways forDIGITAL 400. Each highway is connected to all the respective card connectors;
- Clock impulses, of 8 KHz and 4 MHz.

3. 9 SMALL AUXILIARY MOTHERBOARD (SAX)

An additional small auxiliary motherboard must be installed in multicabinet DIGITAL 400 systems only.

The SAX can be installed as follows:

- in the upper cabinet of a two cabinetDIGITAL 400 system;
- in the middle cabinet of a three cabinet DIGITAL 400 system (the same cabinet in which the MPD card for the respective system is inserted);
- the lower cabinet of a multicabinetDIGITAL 400 system.

The installation of a SAX allows intercabinet access to additional highways. It enables placement of cards with two back connectors to the motherboard in the first three card slots of the middle system cabinet in which the SAX is installed. When possible, place T1 (Style D0 or higher only) E1 (PCM 30 or E1-MFC-R2), PRI24, PRI30, ONS, and HONS cards in slots 2 and 3 of this system cabinet.

A SAX can also be installed in the lower cabinet of a multicabinet DIGITAL 400 system, to provide access from the first three card slots of the lower system cabinet to eight additional highways. In this case, placeT1 (Style D0 or higher only), E1(PCM 30 or E1-MFC-R2), PRI24, PRI30, ONS, and HONS cards in slots 1, 2 and 3 of this system cabinet.

A standard one-cabinet configuration provides up to 128 ports and does not include a SAX motherboard. However, you can order a non-standard configuration containing a SAX motherboard. The addition of a SAX motherboard adds outside lines to the system, enabling a one-cabinet system to support the following:

- 174 ports where a PRI card is used;
- 176 ports where a T1 card is used;
- 188 ports where an E1(PCM 30 or E1-MFC-R2) card is used.

The use of a two-cabinet system with two SAX motherboards adds digital outside line ports to the system. This supports 336 ports when using digital outside line interfaces, such as PRI24, PRI30, T1 or E1 (PCM 30 or E1-MFC-R2).

NOTE

The upper cabinet, supplied as an Extended Cabinet Package, always includes a SAX. However, configuring the SAX in the upper cabinet of a three cabinet installation does not provide additional highways.

THIS PAGE INTENTIONALLY LEFT BLANK

Section 4
PERIPHERAL CARDS

4.1 GENERAL

This section provides a functional description of each of the peripheral cards. It describes replaceable parts, external connectors and switches, jumpers and indicator LEDs.

4.2 COMMON FEATURES

The following hardware features are common to all the system cards:

- Eight bit microcontroller;
- Card based memory (EPROM and RAM);
- Static RAM (SRAM);
- Peripheral Board Controller (PBC);
- LED indicator;
- 25 pair female connectors (except on T1, PRI24, PRI30 cards, and MPD-S400);
- RS-232 configured RJ45 connector (MPD, OCD, COG, COL, CHL, BRS, BRT and BHT only);
- Jumpers;
- EMI and Radio Frequency Interference grounds;
- External tab color coding.

The eight bit microcontroller
Each peripheral card includes an eight bit microprocessor which controls the card's hardware and communications. The microcontroller is able to address 64K RAM and 64K ROM.

Card-based memory (EPROM and RAM)
Each card has a RAM for internal system messages (data messages to be delivered to telephone sets or other cards) and an EPROM which contains the card's program.

Peripheral Board Controller (PBC)
The Peripheral Board Controller mediates between the PCM highways and the external analog/digital voice channels.

LED indicator
Each card has one or more LED indicators which indicate port activity. These LED indications vary from card to card. The MPD card LED and OCD card LED flash on during initialization, but are off during normal system operation.

External connectors
Each T1 card is fitted with two 64-pin female connectors which plug into the motherboard and a DB15 (Style D0 or higher only) connector and an RJ48C connector. One of these is used to connect the card to a Channel Service Unit (CSU), and subsequently to a Central Office, or directly to other PBXs in network configurations.

Each E1 card is fitted with two 64-pin female connectors which plug into the motherboard and a DB15 connector and an RJ48C connector. One of these is used to connect the card to the Central Office, or, directly to other PBXs in network configurations.

Each PRI24/PRI30 card is fitted with two 64-pin female connectors which plug into the motherboard and an RJ48C connector. This is used to connect the card to a Network Terminating and Testing Apparatus (NTTA or NT-1) and to the Central Office, or directly to other PBXs in network configurations.

Each ONS and HONS card is fitted with two 64-pin female connectors which plug into the motherboard.

Each of the other peripheral cards is fitted with one 64-pin female connector which plugs into the motherboard.

Each of the other outside lines, EMD and DID cards, and all line cards, connect to the MDF by a 50-pin female connector. Each card can connect with the following outside lines, telephone sets or terminal elements:

- on each COL card -- eight analog outside lines;
- on each CHL card -- four analog outside lines;
- on each COG card -- eight analog outside lines;
- on each T1 card -- 24 digital outside line channels;

- on each E1 card 30 digital outside line channels;
- on each PRI24 card -- 23 digital ISDN outside line B-channels;
- on each PRI30 card -- 30 digital ISDN outside line B-channels;
- on each BRS card -- eight ISDN terminal elements;
- on each BRT card four S bus ISDN ports (eight digital ISDN outside line B channels);
- on each BHT card two S bus ISDN ports (four digital ISDN outside line B-channels);
- on each ELD card -- up to 16 digital telephone sets;
- on each EHD card -- up to eight digital telephone sets;
- on each ELA card -- eight analog telephone sets
- on each SLD card -- eight SLTs;
- on each SHD card -- four SLTs;
- on each ONS card -- 16 on-site SLTs;
- on each HONS card -- eight on-site SLTs;
- on each DID card -- eight DID lines;
- on each EMD card -- four analog PBX tie lines (2 or 4 wire).

The OCD card connector contains voice channel connections when one or more MIM module is connected to the OCD card, internal modem and DTMF receivers.

RJ45 RS-232 connector

The COG, COL, CHL, BRS, BRT, BHT, RS-232,T1, E1 and OCD cards have RS-232 jacks, which are connected directly to the system's internal LAN.

The RJ45 on the COL, CHL, COG, and RS232 cards are used for the cable ID interface box connection.

The RJ45 jacks on each of these cards enable connection of a printer for Station Message Detail Recording.

The OCD card has an RJ45 jack for connection to IMAGEN.

The MPD card has an RJ45 jack for dedicated connection to the PC for administration purposes, or for alternative connection of an external modem.

The daughterboard has a RJ45 jack which supports the connection to SMDR printers via the ONS or HONS cards.

The T1 and E1 cards have RJ45 jacks for connection to a local debugger.

The RS-232 ports are defined as data circuit-terminating equipment (DCE) devices. You can change this definition with a null modem cable.

Jumpers
An RS-232 ground definition jumper is located on all CO cards, the MPD and the OCD cards. The jumper, set by the technician in the field, determines whether an attached device is signal ground ("natural state") or frame ground. This is important in reducing electromagnetic interference "noise". (Each card may have additional jumpers.)

EMI and Radio Frequency Interference grounds
All the cards have a EMI and Radio Frequency Interference (RFI) ground which prevents radiation emissions from entering or leaving the system cabinet.

External tab color coding
While all lower tabs are brown, the upper tab of each card is color coded for ease of identification, as follows:

Table 4-1 External Tab Color Coding

MPD	orange	ONS	green	PRI30	blue
ELD	green	HONS	green	DID	blue
EHD	green	COL	blue	T1/E1	blue
ELA	green	CHL	blue	EMD	blue
SLD	green	COG	blue	RS-232	blue
SHD	green	PRI24	blue	OCD	yellow
BRS	green				

4.3 CENTRAL OFFICE ANALOG OUTSIDE LINE CARDS

The Central Office analog outside line cards, identified by a blue tab, provide the interface between the DIGITAL system and the Central Office supplied outside lines. This supports most common call seizure processes.

The Central Office analog outside line card performs impulse dialing on outside lines which are defined as impulse dialing lines by the software.

Three types of Central Office analog outside line cards are available:

- COG: Ground or loop start (8 outside lines);
- COL: Loop start (8 outside lines);
- CHL: Loop start (4 outside lines).

The COL/CHL/COG cards can each be divided into the following functional units:

- Peripheral board controller;
- Analog Central Office outside line interface (ACO);
- Microcontroller;
- Memory unit;
- Call progress tone detector.

Peripheral Board Controller
See Section 4.2 above, for peripheral card common resources.

Analog Central Office Outside line Interface
The Signal Processing Code Decoder (CODEC) Filter (SICOFI) is a programmable device and is the interface between the analog outer world and the inner digital world. It can be programmed to customize outside line circuits to suit different PBXs when the DIGITAL system is configured "behind" a PBX.

Microcontroller
See Section 4.2 above, for peripheral card common resources.

Memory unit
See Section 4.2 above, for peripheral card common resources.

Call progress tone detector
One detector services all of the eight outside lines by using time sharing under the control of the card's microcontroller. It detects dial tone, ring back tones, busy tones and error tones, and is used for Automatic Redial and Autodialer features.

Jumpers

- ***Ground definition jumper***
  See Section 4.2, the peripheral board common features section, for information about the RS-232 ground definition jumper.

- ***Ground start suppression jumper (COG cards only)***
  The setting of the ground start suppression jumper enables each circuit to function as either a ground start circuit, a loop start circuit, or a loop start with a polarity detection circuit. Defining a loop start with a polarity detection circuit also requires specifying this option in system administration.

EMI and Radio Frequency Interference grounds
See Section 4.2 for peripheral card common resources.

LEDs
Each outside line circuit has one LED. A steady "on" signal indicates that the outside line circuit is in use. A flashing signal indicates that impulse dialing is in progress.

Provisioning considerations
See Table A-1 for port type limitations and definitions, in Appendix A.

4.4 RS-232 CARD

The RS-232 card, identified by a blue tab, provides a single RJ45 RS-232 connector jack. It is connected directly to the system's internal LAN for connection to a 2400 baud modem, SMDR printers or a caller identification unit.

An RS-232 ground definition jumper is located on the RS-232 card. The jumper, which has to be set by the technician in the field, determines whether an attached device is signal ground ("natural state") or frame ground. This is important in reducing electromagnetic interference "noise".

Provisioning considerations
Each RS-232 channel used must be included (along with serial channels used on other cards) in the maximum number of 17 serial channels available for use. Of the total of 20 serial channels which can be supported by the system, the first three are dedicated by default to Multiple Appearance (MAP), SMDR and the modem.

4.5 T1/E1 DIGITAL OUTSIDE LINE CARD

A single DIGITAL system can have both a T1 (North America) and an E1 (Mexico/Europe) outside line card, identified by a blue tab. The cards must be compatible with the national telephone system where the DIGITAL system is located.

- The T1 card is a digital outside line card which provides the DIGITAL interface to a T1 carrier with 24 PCM channels. The T1 card can emulate any combination of various types of outside lines on its 24 PCM channels, including:

  - Central Office loop start outside lines;
  - Central Office ground start;
  - E&M tie lines;

- DID lines.

- The E1 (PCM 30 or E1-MFC-R2) card is a digital outside line card which provides the DIGITAL interface to an E1 carrier with 30 PCM channels.

The E1 card can emulate various types of outside lines on its 30 PCM channels, including:

- E&M tie lines;
- DID lines;
- DOD lines.

The T1/E1 card can be connected to the Central Office, or can be used to connect two or more DIGITAL systems to create a network.

Although outside lines configured on a T1/E1 card perform DTMF dialing by default, the T1/E1 card performs impulse dialing on outside lines, defined as impulse dialing lines by system administration.

Main functional units

- Carrier interface;
- Switching subsystem;
- Timing unit;
- Digital signal processor.

A block diagram of the main functional subsystems of the T1/E1 card appears in Figure 4-1, below.

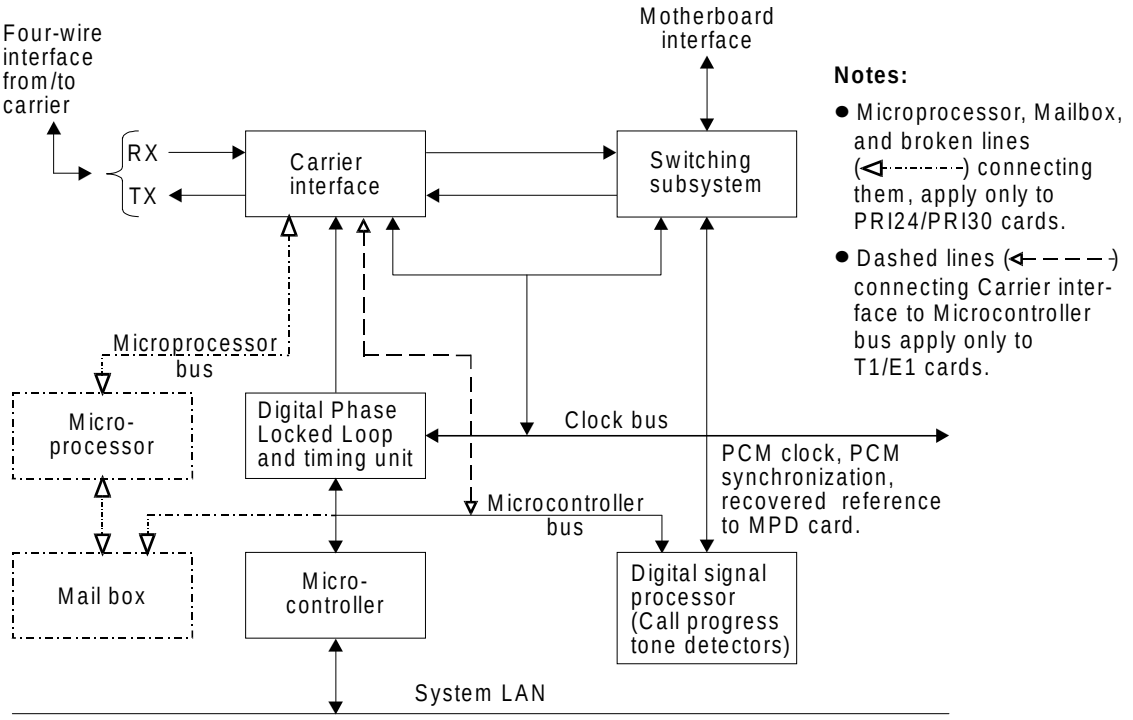


Figure 4-1 T1/E1 card and PRI24/PRI30 card functional block diagram

Carrier interface

The carrier interface controls signal coding and decoding, frame and multiframe alignment and T1/E1 link layer synchronization to the carrier.

The carrier interface includes elements which are controlled and monitored by the system standard 8-bit microcontroller. They do the following:

- make the connection between the T1 card and the line;
- protect the card from high voltage;
- direct data and clock recovery;
- provide for line length selection;
- control local and remote loop-back testing;
- act as a T1/E1 controller to insure frame alignment;
- enable transmission of the Alarm Indicator Signal (AIS -- Blue alarm);
- control signaling.

Switching subsystem

The switching subsystem provides a PCM switching matrix to access all of the time slots on all of the highways. The T1/E1 card can access up to 12 highways via its two 64-pin motherboard connectors.

Timing unit
The timing unit provides the transmission clock that is used by the primary interface. The timing is derived from the Digital Phase Locked Loop (DPLL), which is located on the MPD card.

Digital signal processor (Call Progress Tone Detectors)
The digital signal processor (DSP) services all channels (24 channels on T1 and 30 channels on E1) simultaneously. The digital signal processor detects dial tone, ring back tone, busy tone and error tone and is used for the Automatic Dialer and Automatic Redial features of the DIGITAL system.

Microcontroller
See Section 4.2 above, for peripheral card common resources.

Memory unit
See Section 4.2 above, for peripheral card common resources.

Jumpers
The T1/E1 card has one jumper. Jumper W1 is located adjacent to the RJ45 connector, and is for future use.

EMI and Radio Frequency Interference grounds
See Section 4.2 above, for peripheral card common resources.

Card connectors
The following connectors are mounted on the T1/E1 card.

- ***DB15 connector***
  The female DB15 connector (JP1) is used to connect the T1/E1 card to the Channel Service Unit (CSU) or network.

- ***RJ48C connector***
  The female RJ48C connector (JP2) is one of the connectors that is used to connect the T1/E1 card to the Channel Service Unit (CSU) or network. This connector appears only on style C0 and higher cards.

NOTE

The female RJ48C and DB15 connectors are connected in parallel.

- ***64-pin connectors***
  In two- and three-cabinet DIGITAL 400 systems, where a SAX is installed on the main motherboard of the middle or lower cabinet, respectively, place the T1/E1 card in slot 2 or 3 of the middle cabinet or in slot 1, 2 or 3 of the lower cabinet. In this way, the higher of the two 64-pin connectors (J2) on the T1/E1 card connects to the SAX, thereby providing access to additional highways.

  The lower 64-pin connector (J1) is used to connect the T1/E1 card to the main motherboard in both the DIGITAL KEY BX and DIGITAL 400 systems.

LEDs

Table 4-2, below, lists the number, color and name of each of the five LEDs on the T1/E1 card and defines the function of each LED.

Provisioning considerations

See Table A-1 for port type limitations and definitions in Appendix A.

T1/E1 card applications

The T1/E1 card has two applications:

- Connecting the DIGITAL system to the Central Office;

NOTE

The T1/E1 card must be cabled to a Channel Service Unit (CSU) and from the CSU to the Central Office. The CSU is not provided by Telrad.

- Connecting two or more DIGITAL systems and PBXs in a network.

For further information on T1/E1 card applications, their configuration and installation alternatives, refer to the DIGITAL Family of Systems Administration manual and the DIGITAL Installation manual.

Table 4-2
T1/E1 LED definitions

LED No.	COLOR	NAME	FUNCTION
1 (Lower LED)	RED	Card running	When the led is *not lit*, the card is operating properly.
2	RED	Loopback	LED lights to indicate a loopback, during corresponding maintenance testing.
3	GREEN	OK	If the LED is lit, the interaction between the T1/E1 card and the connected equipment (e.g. Central Office or networked PBX system) is functioning properly.
4	RED	Red alarm	If the LED is lit, the T1/E1 card is in "red alarm state" and is not able to receive signals (i.e., loss of synchronization).
5	YELLOW	Yellow alarm	If the LED is lit, the exchange at the far end is not able to receive your signal (i.e. the far end has sent a remote alarm).
6	RED	None	This LED appears on style A-4 cards, but is not operative.

4.6 ISDN PRI24/PRI30 CARDS

A single DIGITAL system can have either an ISDN PRI24 (North America) or an ISDN PRI30 (Mexico/Europe) outside line card. These cards must be compatible with the national telephone system where the DIGITAL system is located. Where approved by local authorities, a single system will accept these cards.

- The ISDN PRI24 (identified by a blue tab) is a Primary Rate Interface card which provides LT-T (Line Termination -- Trunk) mode interfaces for 23 64 kb/sec B channels and a single D channel for signaling at 64 kb/sec. This provides a total of 1544 kb/sec (including the frame alignment time slot), between the DIGITAL system and the Central Office supplied ISDN outside lines.
- The ISDN PRI30 (identified by a blue tab) is a Primary Rate Interface card which provides LT-T mode interfaces for 30 64 Kb kb/sec B channels and a single D channel for signaling at 64 kb/sec. This provides a total of 2048 Kb per second (including the frame alignment time slot) between the DIGITAL system and Central Office supplied ISDN outside lines.

Functional description

The PRI24/PRI30 cards' main functions are to interface, switch, route, process, and transmit the data sent to or from the DIGITAL system's ISDN outside line and signaling channels.

Main functional units

- Carrier interface;
- Switching subsystem;
- Timing unit;
- Digital signal processor;
- Control unit.

A block diagram of the main functional subsystems of the PRI24/PRI30 card appears in Figure 4-1, above.

Carrier interface

The carrier interface controls signal coding and decoding, frame and multiframe alignment and PRI24/PRI30 link layer synchronization to the carrier.

The carrier interface includes elements (controlled and monitored by the system standard 8-bit microcontroller) which do the following:

- make the connection between the PRI24/PRI30 card and the line;
- protect the card from high voltage;
- direct data and clock recovery;
- provide for line length selection;
- control local and remote loopback testing;
- act as a PRI24/PRI30 controller to insure frame alignment;
- control signaling.

Switching subsystem

The switching subsystem provides a PCM switching matrix to access all of the time slots on all of the highways. The PRI24/PRI30 card can access (via its two 64-pin motherboard connectors):

- up to eight highways on the motherboard in the DIGITAL KEY BX system;
- up to 12 highways in the system (eight on the motherboard and four on the SAX.

Timing unit

The timing unit provides the clocks that are used by the primary interface and switching subsystem components. The timing is derived from the Digital Phase Locked Loop (DPLL), located on the MPD card.

Digital signal processor (Call progress tone detectors)
The DSP services all 23 (or 30) channels simultaneously. The digital signal processor detects dial tone, ring back tone, busy tone and error tone. It is used for the Automatic Dialer and Automatic Redial features of the DIGITAL 400 system. (See the Feature Description Manual.)

Control unit
- One microcontroller for internal system and messages;
- One microprocessor for ISDN layers;
- The microcontroller and microprocessor are connected by the mailbox link.

Flash memory
Two flash memories are as follows:

- 64K for internal system and messages;
- 256K for ISDN layers.

Static RAM (SRAM)
A 64K SRAM and a 256K SRAM store data messages sent between ISDN outside line channels and the system.

Jumpers
The PRI24/PRI30 card has no jumpers.

EMI and Radio Frequency Interference grounds
See Section 4.2 above, for peripheral card common resources.

Card connectors
The following connectors are mounted on the PRI24/PRI30 cards:

- ***Type RJ48C***
  Each PRI24/PRI30 card is fitted with a RJ48C connector, which is used to connect the card to a Channel Service Unit (CSU), and through it to the Central Office.

- 64-pin connectors
  In two- and three-cabinet DIGITAL 400 systems, where a SAX is installed on the main motherboard of the middle or lower cabinet, respectively, place the PRI24/PRI30 card in slot 2 or 3 of the middle cabinet or in slot 1, 2 or 3 of the lower cabinet. In this way, the higher of the two 64-pin connectors (J2) on the PRI24/PRI30 card connects to the SAX, thereby providing access to additional highways.

  The lower 64-pin connector is used to connect the PRI24/PRI30, ONS and HONS cards to the main motherboard.

LEDs

The PRI24/PRI30 cards contain three pairs of LEDs, corresponding to the 186 microprocessor and the 152 microcontroller, with indications as follows:

a. upper paired LED

- lefthand ***red*** LED and righthand ***red*** LED:
  - ***steady red*** -- the card is plugged in, the code is not running
  - ***flashing red*** -- the card is plugged in and the code is running

b. middle paired LED -- Link Status LED indicators

- lefthand ***green*** LED:
  - ***off*** -- no synchronization
  - ***steady green*** -- no alarms, the link is synchronized
  - ***flashing green*** -- no alarms and the link is both synchronized and a clock reference
- righthand ***yellow*** LED:
  - ***steady yellow*** -- local alarm
  - ***off*** -- no alarms

c. lower paired LED

- lefthand ***red*** LED:
  - ***steady red*** -- in loopback state
  - ***off*** -- not in loopback state
- righthand ***red*** LED:
  - ***steady red*** -- remote alarm
  - ***off*** -- no remote alarms

Provisioning considerations

See Table A-1 for port type limitations and definitions, in Appendix A.

4.6.1 The DIGITAL KEY BX system

A maximum of one PRI24/PRI30 card can be installed in each system cabinet.

4.6.2 The DIGITAL 400 system

A maximum of four PRI24/PRI30 cards can be installed in each system cabinet.

For further information on PRI24/PRI30 card applications, their configuration and installation alternatives, refer to the DIGITAL Family of Systems Administration manual, Installation manual and Maintenance manual.

4.7 ANALOG E&M INTERFACE (EMD) CARD

The analog E&M interface (Type I and II A & B side supported, wink start, dial delay, immediate) EMD card provides the DIGITAL system interfaces to one of the following:

- four two-wire audio tie outside line ports;
- two four-wire audio tie outside line ports.

The EMD card can be divided into the following functional units:

- Peripheral board controller;
- Analog Central Office outside line interface (ACO);
- Microcontroller;
- Memory unit;
- Call progress tone detector.

Peripheral Board Controller
See Section 4.2 above, for peripheral card common resources.

Analog Central Office Outside line Interface
The Signal Processing Code Decoder (CODEC) Filter (SICOFI) is a programmable hardware device, which is the interface between the analog outer world and the inner digital world. It can be programmed to customize outside line circuits to suit different PBXs.

Microcontroller
See Section 4.2 above, for peripheral card common resources.

Memory unit
See Section 4.2 above, for peripheral card common resources.

Call progress tone detector
One detector services all of the four tie lines by using time sharing under the control of the card's microcontroller. It detects dial tone, ring back tones and busy tone, and is used for Automatic Redial and Autodialer features.

Ground definition jumper
See Section 4.2 above, for information about the RS-232 ground definition jumper.

LEDs
One LED is provided for each EMD card. When the LED is lit, the card is operating properly.

EMI and Radio Frequency Interference grounds
See Section 4.2 above, for peripheral card common resources.

Provisioning considerations
See Table A-1 for port type limitations and definitions, in Appendix A.

4.8 ANALOG DIRECT INWARD DIALING (DID) CARD

The analog DID card provides the interface between the DIGITAL system and the Central Office supplied incoming analog DID outside lines. The DIGITAL 400 card provides eight DID interfaces. Each port supports one DID outside line, with wink start, dial delay, immediate, etc.

The DID includes a Subscriber Line Interface Circuit (SLIC). This integrated circuit converts four-wire transmission from the DIGITAL system to a two-wire transmission circuit.

External connectors
See Section 4.2, above.

EMI and Radio Frequency Interference grounds
See Section 4.2 above, for peripheral card common resources.

Provisioning considerations
See Table A-1 for port type limitations and definitions, in Appendix A.

4.9 ISDN SUBSCRIBER LINE TERMINATION MODE (BRS) CARD

The ISDN LT-S (Line Termination -- Subscriber) mode BRS card (identified by a green tab) provides four S bus ISDN interfaces between the DIGITAL system and up to eight internal ISDN Terminal Equipment (TE) elements connected to the system. Each bus can support two ISDN terminal element devices.

Functional description
The BRS card's main functions are to interface, switch, route, filter, process and transmit the data sent to or from the

TE elements connected to it. The BRS card can be divided into the following functional units:

- 2 Microcontrollers -- one for the internal system and messages; one for ISDN layers;
- Flash memory;
- S bus interface;
- Peripheral board controller;
- SRAM;
- Power Regulation unit.

Microcontroller
One microcontroller for internal system and messages; one microcontroller for ISDN layers.

Flash memory
Two flash memories are as follows:

- 64K for internal system and messages;
- 256K for ISDN layers.

S bus interface
The S bus interface mediates between the internal protocol used in the card and the ISDN protocol used by the S bus. The interface employs Time Division Multiplexing (TDM) to handle two voice channels (64 Kb/sec each channel) and one data channel (16 Kb/sec) simultaneously.

Peripheral Board Controller
See Section 4.2 above, for peripheral card common resources.

Static RAM (SRAM)
A 32K SRAM and a 256 K SRAM are used for handling card procedures and ISDN.

Power Regulation Unit
Each port has an overcurrent regulation unit which disconnects the telephone set if the current exceeds 300 mA. The telephone set is reconnected automatically when the current is reduced.

Similarly, telephone sets are disconnected if the voltage falls below 24 V. The card's microprocessor reconnects the sets when the voltage returns to the proper level.

LEDs
Each of two red LEDs on the outer edge of the BRS card indicates the operational status of one of the two microcontrollers. A blinking LED indicates that the respective microcontroller is active. A lit or unlit LED indicates that the respective microcontroller is inactive.

EMI and Radio Frequency Interference grounds
See Section 4.2 for peripheral card common resources.

Provisioning considerations
See Table A-1 for port type limitations and definitions, in Appendix A.

4.10 ISDN TRUNK LINE TERMINATION MODE (BRT, BHT) CARDS

The ISDN Trunk Line Termination (LT-T) mode cards, identified by a blue tab, provide the interface between the DIGITAL System and the ISDN outside lines supplied by the Public Exchange. Each card contains a number of ports. The BRT card provides the interface for 4 outside lines. The BHT card provides the interface for 2 outside lines.

These cards control both the B and the D channels of the T interface and control the routing of signalling over the ISDN U-interface and an ISDN S/T-Interface. (See Figure 4-2 below.)

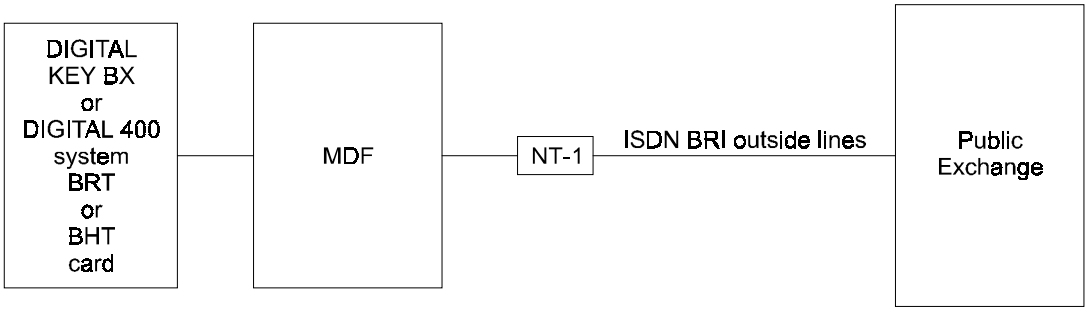


Figure 4-2 NT-1 connection diagram for BRT and BHT cards

Two types of Public Exchange ISDN Trunk cards are available:

- BRT - Supports four S bus ISDN ports;
- BHT - Supports two S bus ISDN ports.

Functional description
The BRT and BHT cards' main functions are to interface, switch, route, filter, process, and transmit the data sent to or from the DIGITAL system's ISDN outside line channels. The BRT and BHT cards can be divided into the following functional units:

- Timing unit;
- 2 Microcontrollers (one for the internal system and messages, and one for ISDN layers);
- Flash memory;
- S bus interface;
- Peripheral Board controller;
- SRAM;
- Timing unit;
- Power Detection unit.

Timing unit
The timing unit provides the clock reference, used by the Digital Phase Locked Loop (DPLL). The timing of the system is derived from the DPLL, located on the MPD card. The DPLL consists of a 2 MHz transmit clock generator.

Microcontroller
- One microcontroller for internal system and messages;
- One microcontroller for ISDN layers.

Flash memory
Two flash memories:

- 64K for internal system and messages;
- 256K for ISDN layers.

S bus interface
The S bus interface mediates between the internal protocol used in the card and the ISDN protocol used by the S bus. The interface employs Time Division Multiplexing (TDM) to handle two voice channels (64 Kb/sec) and one data channel (16 Kb/sec) simultaneously.

Peripheral Board Controller
See Section 4.2 above, for peripheral card common resources.

Static RAM (SRAM)
A 64K SRAM and a 256 K SRAM are used for storing data messages sent between ISDN outside line channels and the system.

Power Detection Unit
The power detection unit detects the presence of power (between 24V and 42V) on ISDN outside line channels.

LEDs
The BRT card contains six LEDs, one single-color (red) LED for each of the two processors, and one dual color (green/yellow) LED for each of the four interfaces. Their location is as follows:

- ***red* LEDs** -- Each of the two red LEDs on the outer edge of the BRT and BHT cards indicates the operational status of one of the two microcontrollers.
  * ***lit*** -- indicates that the respective microcontroller is powered on, but not running.
  * ***blinking*** --indicates that the respective microprocessor is running;
  * ***unlit*** --indicates that the respective microprocessor is inactive

- ***green/yellow dual color LEDs*** ---A dual color green/yellow LED on the outer edge of BRT and BHT cards indicates the operational status of each S bus ISDN port on each card. i.e., four such LEDs on the BRT card and two such LEDs on the BHT card.

  * ***lit green*** --indicates that the respective S bus is synchronized;
  * ***blinking green*** -indicates that the respective S bus is active and serves as the synchronization reference guided by the MPD card's DPLL unit;
  * ***lit yellow*** - indicates that the respective S bus is powered on, but synchronized;
  * ***unlit yellow*** --indicates that the respective S bus is not powered.

Radio Frequency Interference grounds
See Section 4.2 above, for peripheral card common resources.

Provisioning considerations
See Table A-1 for port type limitations and definitions, in Appendix A.

4.11 EXECUTIVE LINE CIRCUIT (ELD AND EHD) CARDS

The Executive Line Circuit card provides the interface between the proprietary digital family of telephone sets and the DIGITAL system. Each card contains a number of ports, each of which can support up to two telephone sets, depending on the particular installation configuration. See Table A-1 in Appendix A.

The ELD card controls both the B and the D channels of the S-interface. The ELD card controls the routing of packet switched data over the D channel. The card is supplied in two versions:

- ELD -- The 8-port ELD card supports eight S-buses and provides interfaces for up to 16 proprietary digital telephone sets.
- EHD -- The 4-port EHD card is similar to the ELD card, but supports four S-buses and provides interfaces for up to eight proprietary digital telephone sets.

Functional description

The ELD/EHD cards' main functions are to interface, switch, route, filter, process, and transmit the data sent to or from the DIGITAL system's proprietary digital telephone sets. The ELD/EHD can be divided into the following functional units:

- Microcontroller;
- EPROM;
- S bus interface;
- Peripheral Board controller;
- SRAM;
- Power Regulation unit.

Microcontroller

See Section 4.2 for peripheral card common resources.

EPROM

See Section 4.2 for peripheral card common resources.

S bus interface

The S bus interface mediates between the internal protocol used in the card and the ISDN protocol used by the S bus. The interface employs Time Division Multiplexing (TDM) to handle two voice channels (64 Kb/sec each channel) and one data channel (16 kb/sec), simultaneously.

Peripheral Board controller

See Section 4.2 above, for peripheral card common resources.

Static RAM (SRAM)

A 64K SRAM, consisting of two 32K components is used for storing data messages sent between telephone sets and the system.

Power regulation unit

Each port has an overcurrent regulation unit which disconnects the telephone set if the current exceeds 300 mA. The telephone set is reconnected automatically when the current is reduced.

Similarly, telephone sets are disconnected if the voltage falls below 35 V. The card's microprocessor reconnects the sets when the voltage returns to the proper level.

EMI and Radio Frequency Interference grounds
See Section 4.2 above, for peripheral card common resources.

Provisioning considerations
See Table A-1 for port type limitations and definitions, in Appendix A.

4.12 EXECUTIVE LINE ANALOG (ELA) CARD

The Executive Line Analog card provides the interface between a family of Telrad's analog telephone sets and the DIGITAL system. Each card contains eight ports and can support up to eight single audio path (SAP) or dual audio path (DAP) analog telephone sets, with no more than one set connected to each port.

Functional description
The ELA card's main functions are to interface, switch, route, filter, process, and transmit the data sent to or from the analog telephone sets connected to the DIGITAL system. The ELA card can be divided into the following functional units:

- Microcontroller;
- EPROM;
- Telephone set interface;
- Peripheral Board controller;
- SRAM;
- Power Regulation unit.

Microcontroller
See Section 4.2 above, for peripheral card common resources.

EPROM
See Section 4.2 above, for peripheral card common resources.

Telephone set interface
The telephone set analog interface provides audio and handsfree communications via two telephone set pairs and data communication via the third telephone set pair. Power feed to the telephone sets is provided via the data link and the main audio link by a phantom connection.

Peripheral Board controller
See Section 4.2 above, for peripheral card common resources.

Static RAM (SRAM)
A 64K SRAM, consisting of two 32K components is used for storing data messages sent between telephone sets and the system.

Power regulation unit
Telephone sets are disconnected if the voltage falls below 35 V. The card's microprocessor reconnects the sets when the voltage returns to the proper level.

EMI and Radio Frequency Interference grounds
See Section 4.2 above, for peripheral card common resources.

Provisioning considerations
See Table A-1 for port type limitations and definitions, in Appendix A.

4.13 SLD AND SHD CARDS

The SLD and SHD cards provide the interface between the DIGITAL system and eight industry standard, type 500 (impulse) or type 2500 (tone) single line telephones located within 3.6 miles of the system cabinet. These telephones can be on premise extensions or off-premise extensions (OPXs). (The OL13C circuit code is given to the central office when ordering OPX circuits).

The cards also provide the SLD communications protocol, SLT operating and signaling voltages and protection against voltage surges.

The SLD and SHD card are also used to connect announcers, VS&F, external modems, fax machines, etc. The SLD and SHD cards provide the following SLT support services:

- Route ring voltage from either the:
  - external ringer unit to SLTs connected to the SLD card; or
  - built-in ringer on the SHD card to SLTs connected to this card;
- Onhook/offhook status detection;
- Turn on the message indicator -- on SLTs connected to the SLD card only;
- Hook flash detection;
- Assign ring and tone rates for each SLT;
- Identify DTMF tones;
- Identify impulse dialing.

The SLD and SHD cards can be divided into the following functional units:

- Microcontroller;
- Memory unit;
- Peripheral Board controller;
- Power supply unit;
- Analog SLT interface;
- DTMF receivers.

Microcontroller
See Section 4.2 above, for peripheral card common resources.

Memory unit
See Section 4.2 above, for peripheral card common resources.

Peripheral Board controller
The Peripheral Board controller (PBC) mediates between the microcontroller and the SLIC to transmit the audio and control signaling.

Power supply unit, SLT ringer and SLT message lamp generator

- ***Power sources***
  The SLD card includes the following power sources for:
  - internal or external ringer: 86 V RMS, 20 Hz ringing voltage;
  - message module: -110 V DC voltage.

- ***External ringer***
  If a Telrad external ringer is connected to the system, a ringer daughterboard can be mounted on an SLD card. The 4-pin connector on the ringer daughterboard must be wired to the external ringer.

  One external ringer can serve up to 96 SLTs connected to SLD, ONS or HONS cards.

- ***Message lamp generator***
  The power for the SLTs' message lamp indicators connected to SLD cards is supplied via a message lamp generator built in to the card.

The SHD card does not support SLT message lamps.

A summary of available methods of supplying ringer and message lamp power to SLTs connected to either SLD, SHD, ONS or HONS cards is shown in Table 4-3, below.

Table 4-3
SLT ringer and message lamp support summary

Device	Method	Card type			
		SLD	SHD	ONS	HONS
External ringer	4-pin connector built-in on the card	--	--	X	X
	mount onto the card -- on site -- the ringer daughterboard with its 4-pin connector, for connection to the external ringer	X	--	--	--
Message lamp generator	message lamp generator built-in on the card	V	--	--	--
	mount the message lamp generator daughterboard onto the card -- on site	--	--	X	X

The analog SLT interface
The card includes a SICOFI component which performs the analog-digital conversion. It also includes a SLIC component, which converts four-wire transmission of a DIGITAL system to two-wire transmission of SLTs.

DTMF receivers
Each SLD and SHD card includes two DTMF receivers which interpret DTMF dialing of SLTs.

Jumpers (on SLD card only)
The W100 - W800 jumper is normally in place to enable message voltage. The jumper must be removed to cancel message voltage if the SLT is defined as an OPX. One jumper is provided for each port.

EMI and Radio Frequency Interference grounds
See Section 4.2 for peripheral card common resources.

Provisioning considerations
See Table A-1 for port type limitations and definitions, in Appendix A.

One ringer is required for any DIGITAL 400 system cabinet containing SLTs.

4.14 ONS AND HONS CARDS

Functional description
The on-site ONS and HONS cards provide the interface between the individual industry standard 500 or 2500 model on site SLT telephones, located up to 3.0 miles from the system cabinet and the DIGITAL system. The number of SLT ports supported by these cards are as follows:

- ONS -- 16;
- HONS -- 8.

NOTE

ONS/HONS circuits cannot be used for OPX connections.

The cards also provide the ONS communications protocol, SLT operating and signaling voltages and protection against voltage surges.

The ONS and HONS cards provide the following SLT support services:

- Onhook/offhook status detection;
- Hook flash detection;
- Route ring voltage from the ringer unit to SLTs;
- Assign ring and tone rates for each SLT;
- Identify DTMF tones;
- Identify impulse dialing.

The ONS and HONS cards can be divided into the following functional units:

- Microcontroller;
- Memory unit;
- Peripheral Board controller;
- Power supply unit;
- Analog SLT interface;
- DTMF receivers.

Microcontroller
See Section 4.2 above, for peripheral card common resources.

Memory unit
See Section 4.2 above, for peripheral card common resources.

Peripheral Board controller
The Peripheral Board controller (PBC) mediates between the microcontroller and the SLIC for the purpose of transmitting the audio and control signaling.

64 pin connector
Two 64-pin connectors are mounted on the rear of ONS and HONS cards, for connection to the SAX motherboard.

RS-232 daughterboard
A daughterboard can be connected to an ONS or HONS card. It has an RS-232 configured serial communication port to provide connection with an SMDR printer.

Power supply unit, SLT ringer and SLT message lamp generator

- ***Power sources***
  The ONS and HONS cards include the following power sources for:
  * internal or external ringer: 86 V RMS, 20 Hz ringing voltage;
  * message module: -110 V DC voltage.

- ***External ringer***
  If a Telrad external ringer is connected to the system, the 4-pin external connector on an ONS or HONS card can be wired to the ringer.

  One external ringer can serve up to 96 SLTs connected to SLD, ONS or HONS cards.

- **Message lamp generator**
  A message lamp indicator daughterboard unit must be installed on each ONS and HONS card to which SLTs with message lamps are connected.

  For a summary of available methods of supplying ringer and message lamp power to SLTs connected to either SLD, SHD, ONS or HONS cards, see Table 4-3, above.

The Analog SLT interface

The card includes a SICOFI component which performs the analog-digital conversion and a SLIC component, which converts four-wire transmission of DIGITAL system to two-wire transmission of SLTs.

DTMF receivers

Each ONS and HONS card includes two DTMF receivers which interpret DTMF dialing of SLTs.

Jumpers

None.

EMI and Radio Frequency Interference grounds

See Section 4.2 above, for peripheral card common resources.

Provisioning considerations

See Table A-1 for port type limitations and definitions, in Appendix A.

One ringer is required for any DIGITAL KEY BX system containing SLTs.

In the DIGITAL 400 system, one ringer is required for 96 SLTs.

4.15 OPTION CARD (OCD)

The OCD card serves as a physical and logical platform for the DIGITAL system option modules. The OCD card operates at a maximum baud rate of 9600 bps (D style). You can program the old baud rate to match the peripheral equipment it is supporting.

The following are the DIGITAL system option modules:

- Multiple Interface Module (MIM), which support audio channels, sensors and relays, for connection of door units, external page zones, external bells, IMAGEN, and MOH/BGM port;
- one modem module per system, for remote administration and maintenance, with a baud rate of 2400 bps modem module;
- a DTMF module, containing four DTMF receivers.

The option modules are units with connecting pins. Each module contains its own firmware. Each module has its own LED.

Each OCD card can contain up to three modules of any type. The option modules are described below.

The 2400 baud modem module and the DTMF receiver modules attach to the OCD card without any other preparation. The MIM module is described in further detail in the DIGITAL Installation manual.

Provisioning considerations

DIGITAL KEY BX system A maximum of three OCD cards can be installed in the system. Each OCD card can support up to three option modules. A maximum of nine Option modules can be installed in the system.

DIGITAL 400 system A maximum of ten OCD cards can be installed in the system. Each OCD card can support up to three option modules. A maximum of 30 Option modules can be installed in the system. For further details on provisioning considerations, see Appendix A.

4.16 MULTIPLE INTERFACE MODULE (MIM)

The MIM provides the software and hardware resources required to connect external devices such as IMAGEN, door

units, external page, MOH/BGM and external bells to a DIGITAL system.

The hardware resources provided include four two-wire duplex audio channels, two relays, and two sensors.

Resource requirements
The MIM provides four audio channels. The IMAGEN cards come in 2 or 4 port models which use 2 or 4 audio channels.

Door unit interface: One two-wire audio channel, two relays, and one sensor.

External page interface: One simplex audio channel and one relay.

External bell interface: One relay.

External connector: The Multiple Interface Module (MIM) has an RCA female connector for MOH/BGM.

DIP switches
DIP (Dual In Line Package) switches are located on the bottom of the module on the module surface containing the connecting pins. DIP switches define the relay path. For example, the DIP switches enable designation of relay #2 as "normally open" (NO) or "normally closed" (NC).

Provisioning considerations
DIGITAL KEY BX system Up to five MIM modules can be programmed in the system.

A maximum of three MIM modules can be used for connecting IMAGEN.

A maximum of two MIM modules can be used for connecting external equipment.

Each IMAGEN port used must be included in the maximum number of 96 extension ports which can be supported by the system. See Table A-1 for summary of port type limitations and definitions.

DIGITAL 400 system A maximum of 12 MIM modules can be programmed in the system. A maximum of four MIM modules can be used for connecting IMAGEN.

A maximum of eight MIM modules can be used for connecting external equipment.

Each IMAGEN port used must be included in the maximum number of 254 extension ports which can be supported by the system. See Table A-1 for a summary of port type limitations and definitions.

4.17 MODEM MODULE

The 2400 bps modem module provides the DIGITAL system with an internal modem for remote administration and maintenance.

The 2400 bps Modem Module is a proprietary device using the following:

- V22.bis, V22 communications protocol, MNP 2-4 and V42 error correction and detection protocols;
- MNP 5 and V42.bis compression/decompression protocols.

External connector
The modem module has no external connector.

Provisioning considerations
Only one modem module can be included in an entire DIGITAL system.

DIGITAL KEY BX system When a modem module is used, it must be included in the maximum number of 96 extension ports which can be supported by the system. See Table A-1 for a summary of port type limitations and definitions.

DIGITAL 400 system When a modem module is used, it must be included in the maximum number of 254 extension ports which can be supported by the system. See Table A-1 for a summary of port type limitations and definitions.

4.18 DTMF MODULE

Each DTMF module provides the DIGITAL system with four independent DTMF receivers which recognize 16 different tone pairs.

Provisioning considerations
The permissible number of DTMF modules to be installed (with four DTMF receivers each) depends on the number of SLD, SHD, and DID cards in the system and the use of DTMF receivers on those cards. This limitation is determined by the location of other DTMF receivers, as follows:

- one on the MPD card;

- two on each DID, SLD, SHD, ONS and HONS card.

4.18.1 The DIGITAL KEY BX system

The maximum number of DTMF receivers in the system is 17. The maximum number of DTMF modules in the system is four. A maximum of nine DTMF receivers will be allocated for the entire system, using the MPD, SHD, SLD or DID cards, when no DTMF modules or ONS/HONS cards have been installed.

This limitation is determined by the location of DTMF receivers (up to a total of 17 DTMF receivers in the system) as follows:

- one on the MPD card;
- two on each DID, SLD, SHD, ONS and HONS card;
- four on each DTMF module.

4.18.2 The DIGITAL 400 system

The maximum number of DTMF receivers in the system is 37. The maximum number of DTMF modules in the system is nine.

A maximum of nine DTMF receivers will be allocated for the entire system, using the MPD, SHD, SLD or DID cards, when no DTMF modules or ONS/HONS cards have been installed.

This limitation is determined by the location of DTMF receivers (up to a total of 37 DTMF receivers in the system) as follows:

- one on the MPD card;
- two on each DID, SLD, SHD, ONS and HONS card; four on each DTMF module.

THIS PAGE INTENTIONALLY LEFT BLANK

Section 5
POWER SUPPLY

5.1 POWER SUPPLY UNIT

The internal power supply unit, located in each installed system cabinet, converts the 110 Vac/60 Hz (North America) or 230 Vac/50Hz (Europe) input power into the DC voltages for the cards and terminal equipment. Figure 5-1 shows the power supply units for both the DIGITAL KEY BX system and the DIGITAL 400 system.

The power supply unit supplies ±5V for the logic circuitry of the system as well as -48V for the proprietary digital and analog telephone sets. The -48V serves as line voltage for SLD, SHD, ONS and HONS cards, and is used to generate ringer voltage via the ringer module on one of the SLD, SHD, ONS and HONS cards. The 110V message waiting voltage for SLT telephone sets is converted, from -48V, on the SLD, SHD, ONS and HONS cards containing the ringer module.

The power supply unit uses hybrid linear/switching technology to generate the -48V and the ±5V.

5.2 BATTERY BACKUP UNIT (BBU)

A BBU is available only for the DIGITAL KEY BX system. When a BBU is connected to the system, a special power supply unit is installed. It contains backup and control circuit and is installed in, or next to, one of the system cabinets. The battery pack cable is connected to the special power supply.

The two-hole -48 Vdc connector on the front panel of the DIGITAL 400 power supply (shown in Figure 5-1) can be used to connect a customer supplied BBU to the system.

5.3 UNINTERRUPTABLE POWER SUPPLY (UPS)

A UPS can be installed as a backup for the power supply, with a power capacity suited to the DIGITAL system and the number of system cabinets, as follows:

- DIGITAL KEY BX system (150 VA per system cabinet);
- DIGITAL 400 system (500 VA per system cabinet).

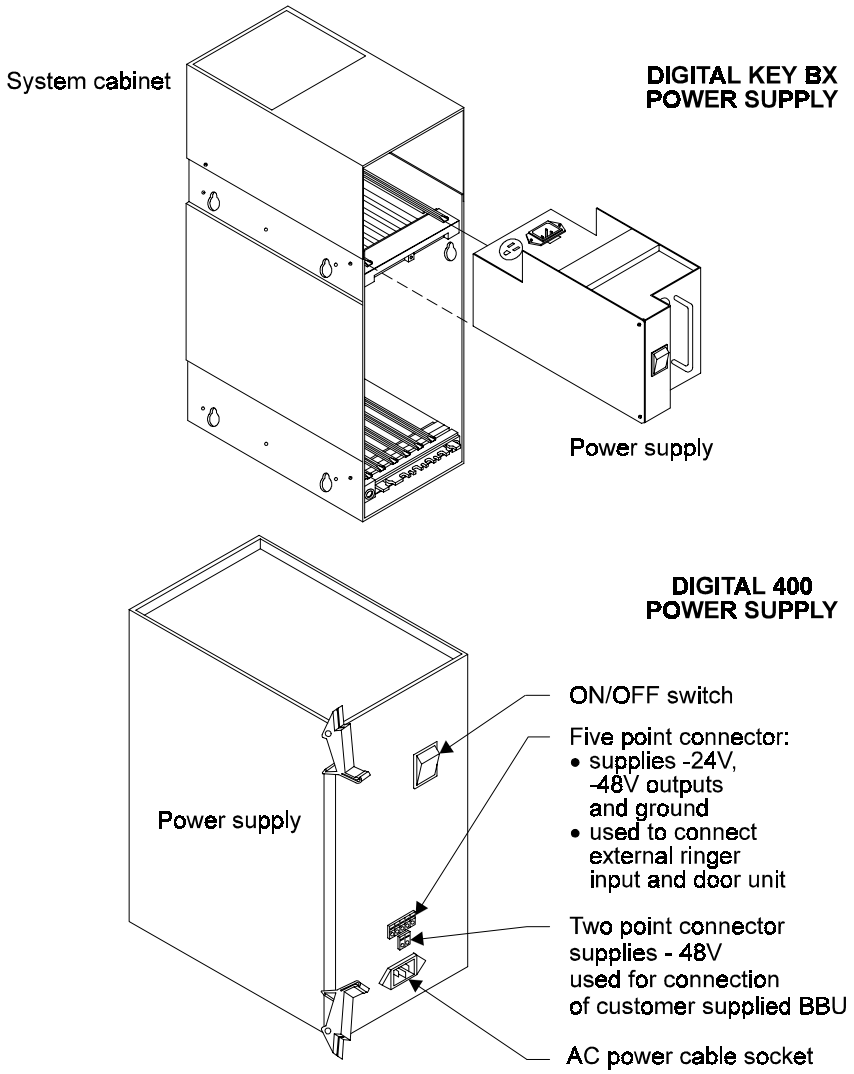


Figure 5-1 DIGITAL KEY BX and DIGITAL 400 power supply units

5.4 POWER SUPPLY EXTERNAL CONNECTORS AND SWITCHES

An ON/OFF switch is lit when the power supply unit is operational.

In the DIGITAL KEY BX system cabinet, a cable terminating in a 12 pin female connector, connects the power supply to the motherboard.

In the DIGITAL 400 system cabinet, the power supply is inserted into the system cabinet. A connector on the rear of the power supply plugs into its counterpart connector on the main motherboard, similarly to the card insertion.

The power socket includes an RFI noise filter for connecting the power supply unit to the power source cable.

A power outlet is provided for supplying power to the linked cabinets in a multicabinet system. (This applies to the DIGITAL KEY BX system only.)

Each power supply unit has a six foot long power source cable which plugs into the power socket or the power supply, on one end, and the power source outlet or the adjacent cabinet power supply (DIGITAL KEY BX) or power strip on the wheel unit (DIGITAL 400), on the other.

Linking system cabinets
See Section 3. 4 above.

5.5 POWER SUPPLY PROVISIONING CONSIDERATIONS

One power supply unit is required per system cabinet.

THIS PAGE INTENTIONALLY LEFT BLANK

Section 6
TERMINAL EQUIPMENT

6.1 INTRODUCTION

This section provides a description of the common features of the telephone sets together with specific details of each telephone set.

Two families of telephone sets are available to users in a DIGITAL system; a digital family and an analog family.

The options available for each telephone set in each family are detailed in Table 6-1 below. The map abbreviation column, on the right, gives the abbreviation used for each telephone set in the administration maps.

Various alternative configurations of the digital and analog telephone sets are presented in Section 8.1.

Table 6-1
Summary of telephone set characteristics

family	set type	reference		display size	number of program-mable keys or softkeys	audio path		map abbreviation in PCP	available options	
		text section no.	figure no.			DAP	SAP		Add-on unit	data card
Digital	Executive set without display	Section 6.3.3	6-1	--	36	X	X	EXD	X	X
	Executive set with expanded display	Section 6.3.1	6-1	8 x 24	36+12 soft	X	X	EXD	X	X
	Executive set with display	Section 6.3.2	6-2	2 x 24	36+10 spd	X	X	EX1	X	X
	Display Speakerphone set	Section 6.4.1	6-3	2 x 16	16	X	X	SD	X	X
	Speakerphone set	Section 6.4.2	6-4	--	16	X	X	SD	--	X
	16 Button set	Section 6.5.1	6-5	--	16		X	SD	--	--
	4 Button set	Section 6.5.2	6-6	--	4		X	BA	--	--
Analog	Executive station	Section 6.6.1	6-7	1 x 16	24	X		EX	--	--
	Standard display station	Section 6.6.2	6-7	1 x 16	16	X		ST	--	--
	Basic Key set	Section 6.6.3	6-8	--	16	X		BK	--	--
	Four Button Plus set with speakerphone	Section 6.6.4	6-9	--	4	X	--	FB	--	--
	Four Button Plus set w/o speakerphone					--	X			
SLT	Single line telephone	Section 6.7	--	--	--	--	X	--	--	--
Telrad Tracker	Cordless Station	Section 6.8	6-10		4		X	SD	--	--

6.1.1 The digital family of telephone sets

The digital family of telephone sets in the DIGITAL systems are custom designed for use with these systems. The common features of the telephone sets in this family and those of each set type are discussed below.

6.1.2 The analog family of telephone sets

The telephone sets of the analog family are supported by the DIGITAL systems, as well. The common features of the telephone sets in this family and those of each set type are discussed below.

6.2 COMMON FEATURES OF DIGITAL TELEPHONE FAMILY SETS

6.2.1 Technology

Each of the digital telephone family sets contains an 8051 microprocessor, which supports data signaling between the sets and the system cabinet. Digital conversion is performed in the sets. The sets are compatible with ISDN level one (Physical layer).

6.2.2 Hardware

The proprietary telephone sets consist of the following:

- a base fitted with a cradle and handset;
- a speaker;
- a microphone;
- a dial pad;
- fixed feature buttons;
- programmable buttons (which can be defined as feature buttons, direct station selection (DSS) buttons or speed dialing (SPD) buttons).

The status of a feature, extension or outside line, allocated to a programmable button, is indicated by a single or dual-color (red/green) LED. The LED flash rate provides the user with additional status information.

In addition to the various fixed and programmable buttons, all sets have a feature button which, in conjunction with the appropriate feature code, enables the user to access any system feature.

The upper panel may contain extra buttons or variously sized displays, depending on the particular telephone set model. On some sets, this upper panel is adjustable. All sets have a multifunction **[<LO HI>]** button which regulates the following:

- display contrast (if operated while the telephone is not in use), ringing volume (if operated during ringing);
- speaker volume (if operated while speaker is in use);
- handset volume (if operated while the handset is in use).

The **[<LO HI>]** button is also used to scroll messages when reading more than one message.

Each set contains its own memory, both nonvolatile (EPROM and ROM) and volatile (RAM). The nonvolatile memory is used to store the telephone set's directory number (DN) profile identification. The DN uniquely identifies the set and is used by the system to verify set compatibility with the line when the system is reset or when the set is reconnected to the line. The memories provided for each type of telephone set, are detailed below:

	Executive	Display Speakerphone and Speakerphone	16 Button and 4 Button
ROM	8K/2K	8K	8K
RAM	2K	2K	--
EPROM	YES	YES	YES

The sets operate with an internal proprietary protocol which supports the features specific to a DIGITAL system.

Telephone sets are supplied with several labels to enable the user to customize the programmable buttons.

All the telephone sets can be wall mounted. They are supplied in one of two colors (gray or black) and a choice of handsets.

6.3 THE DIGITAL FAMILY EXECUTIVE SETS

6.3.1 Executive set with expanded display

The Executive set with expanded display (See Figure 6-1) is a multibutton digital telephone set with an expanded display for softkey operation and speakerphone. Single channel Universal data cards and TAPI/TelradLINK data cards installed in this telephone set perform protocol conversion. This enables a PC to connect to the DIGITAL system and operate with appropriate Telrad Console, DIGITAL, CSD, TAPI, TSAPI, TelradLINK, CSV or ACD I.Q. software.

The set can be configured for either a single audio path (SAP) or a dual audio path (DAP). The set supports offhook voice announce with handsfree answerback.

In addition to the standard 12-button dialpad, the Executive set with expanded display features ten fixed function buttons, 28 programmable buttons with dual-color LEDs and eight with single color LEDs, six menu-driven softkeys, and six worktable softkeys.

The adjustable display panel has an eight line by 24 character dot matrix, liquid crystal display (LCD) which provides two rows of information (time, date, call progress indications, etc.). It also has software controlled prompts for the six softkeys mounted on either side of the display.

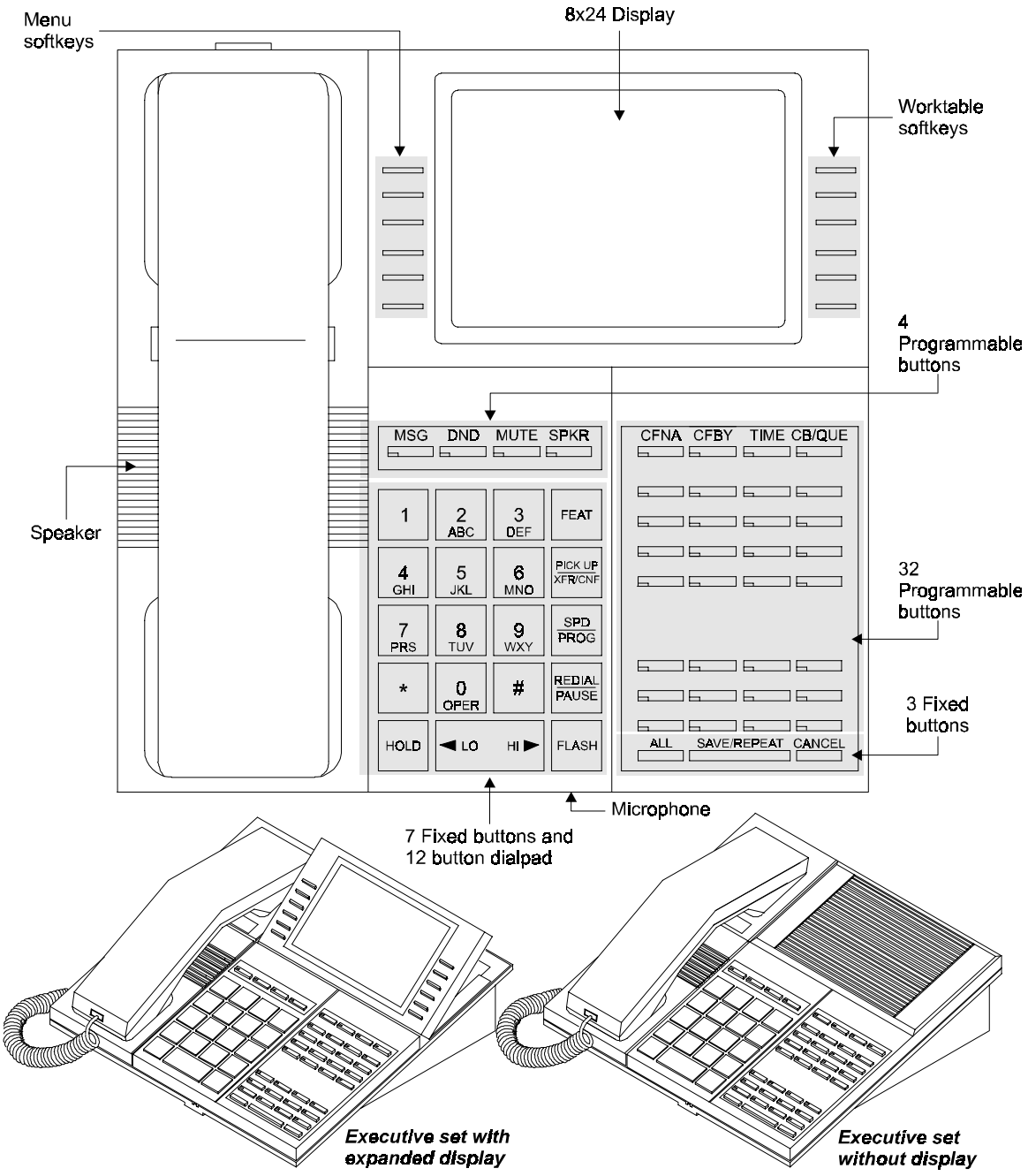


Figure 6-1 Executive set with expanded display and Executive set without display

Softkeys change their function dynamically, depending on the current status of a call. You can operate more than 30 features from just six softkeys. In addition, softkeys simplify set operation by showing all the currently valid options. Features not currently applicable are not displayed. Additional softkey prompts for IMAGEN, Electronic Business Card, and System Dial By Name (SDBN), caller ID list and caller features appear on the set's expanded display when the software for that option is installed.

The Executive set can be enhanced further by attaching up to four 36 button Add-on units (See Figure 6-12).

6.3.2 The Executive set with display

The Executive set with display (See Figure 6-2) is equipped with a two line by 24 character dot matrix liquid crystal display (LCD). It provides information as to time and date, call destination status, call progress status and other call indications. The adjustable display panel contains ten speed dial buttons in addition to the 36 programmable buttons on the telephone set's base.

Single channel Universal data cards and TAPI/TelradLINK data cards installed in this telephone set, perform protocol conversion. This enables a PC to connect to the DIGITAL system and operate with appropriate CSD, TAPI, TSAPI, TelradLINK, CSV or ACD I.Q. software.

The set can be configured for either a single audio path (SAP) or a dual audio path (DAP). The set supports offhook voice announce with handsfree answerback.

The Executive set with display can be enhanced further by attaching up to four 36 button Add-on units (See Figure 6-12).

6.3.3 The Executive set without display

The Executive set without display has a a non-adjustable, sealed upper panel with neither a display nor buttons. The 36 programmable button arrangement on the telephone set's base is identical to that of the other two Executive sets. (See Figure 6-1.)

Single channel Universal data card and TelradLINK data cards installed in this telephone set, perform protocol conversion. This enables a PC to connect to the DIGITAL system and operate with appropriate Telrad Console, CSD, TAPI, TSAPI, TelradLINK, CSV or ACD I.Q. software.

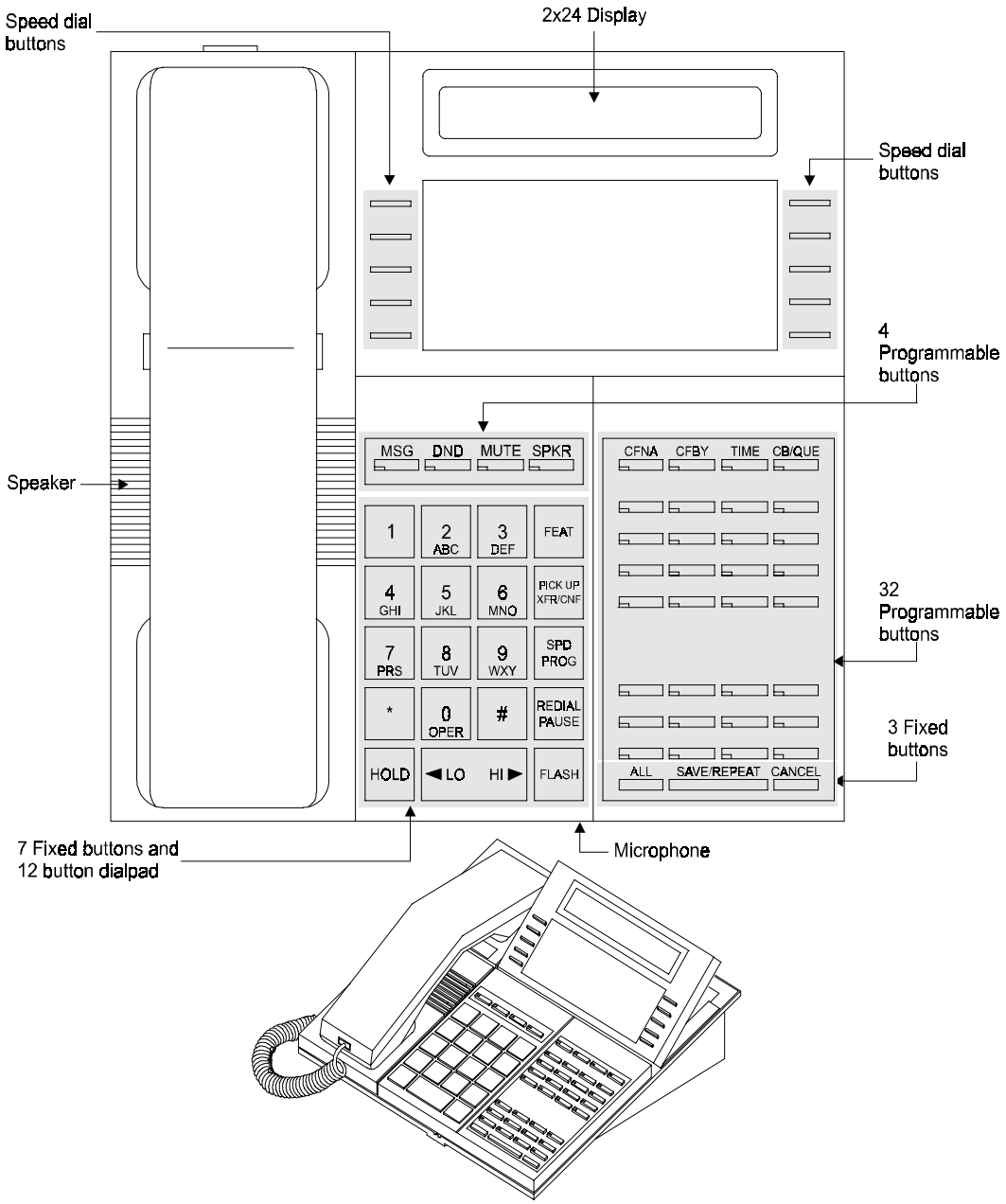


Figure 6-2 Executive set with display

The set can be configured for either a single audio path (SAP) or a dual audio path (DAP). The set supports offhook voice announce with handsfree answerback.

The Executive set can be enhanced further by attaching up to four 36 button Add-on units (See Figure 6-12).

6.4 THE DIGITAL FAMILY SPEAKERPHONE SETS

6.4.1 Display Speakerphone set

The Display Speakerphone set (See Figure 6-3) is also equipped with the standard dialpad and adjacent fixed function buttons. The four programmable buttons, in the row above the dialpad, have dual color LEDs.

The Display Speakerphone set has twelve programmable buttons situated on the flat upper panel, with a two line by 16 character LCD display, sloped at a convenient fixed angle, at the upper end of the panel. The twelve programmable buttons on the upper panel incorporate dual-color LEDs to indicate the status of each button's programmed feature.

The display provides the same time, date and call progress information as provided by the Executive sets.

Single channel Universal data cards and TAPI/TelradLINK data cards installed in this telephone set perform protocol conversion. This enables a PC to connect to the DIGITAL system and operate with appropriate CSD, TAPI, TSAPI, TelradLINK, CSV or ACD I.Q. software.

The set can be configured for either a single audio path (SAP) or a dual audio path (DAP). The set supports offhook voice announce with handsfree answerback.

The Display Speakerphone set can be enhanced further by attaching up to four 36 button Add-on units (See Figure 6-12).

6.4.2 Speakerphone set

The Speakerphone set (See Figure 6-4) has no display and cannot accept a 36 button Add-on unit. In all other respects, it is identical to the Display Speakerphone set.

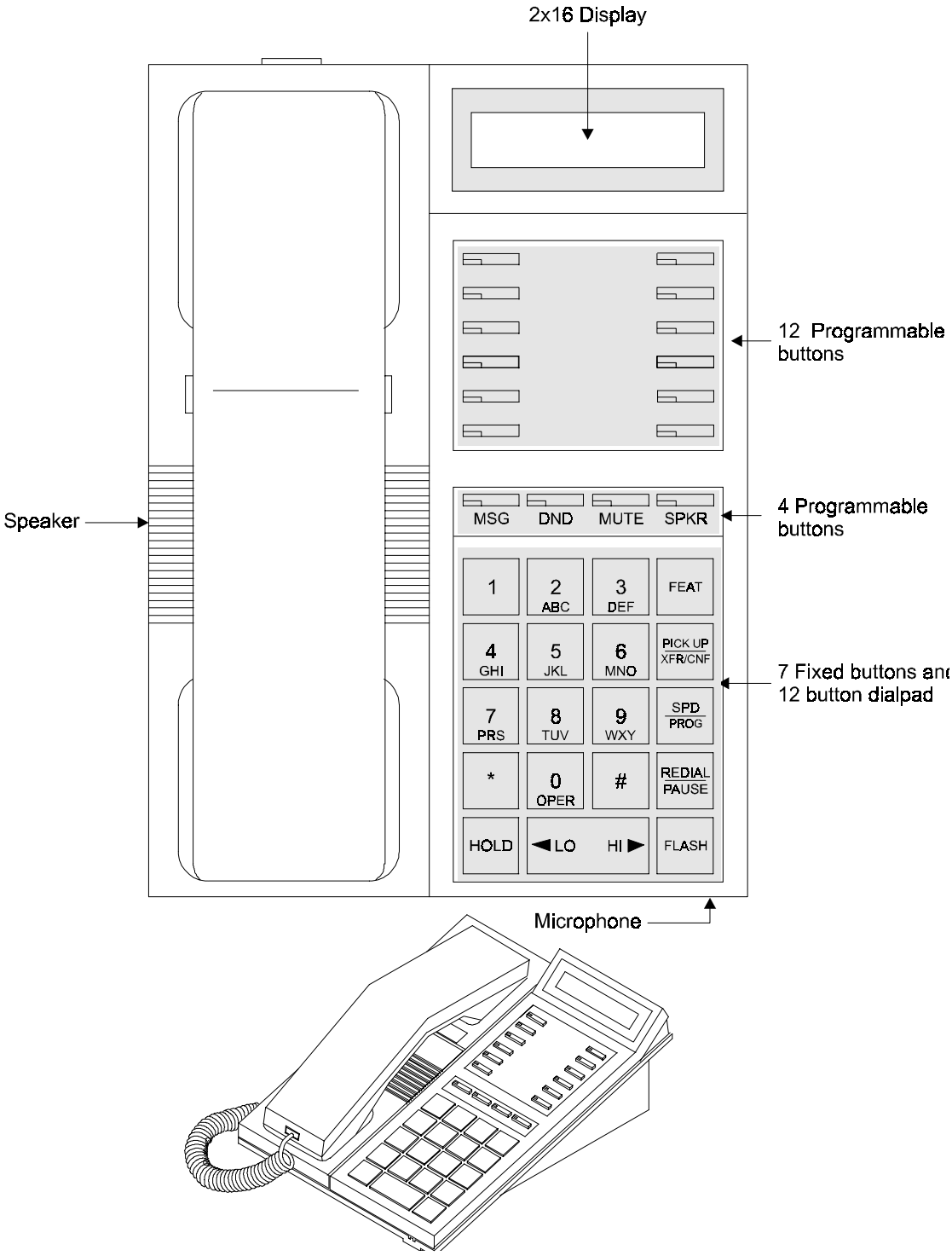


Figure 6-3 Display Speakerphone telephone set

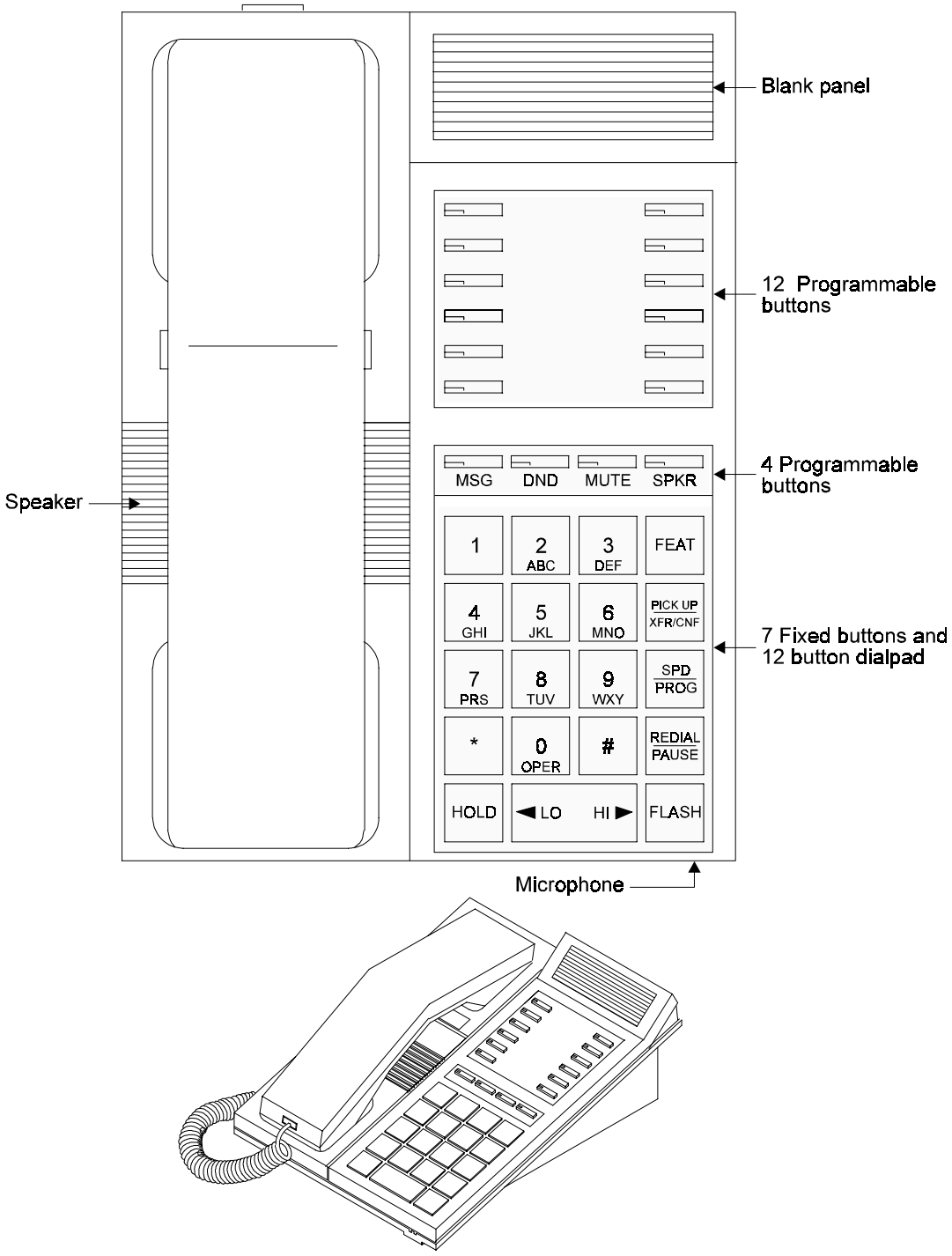


Figure 6-4 Speakerphone set

6.5 THE DIGITAL FAMILY 16 BUTTON AND FOUR BUTTON SETS

6.5.1 16 Button set

The 16 Button set (See Figure 6-5) provides twelve programmable buttons with dual color LEDs on its upper panel. The set has handsfree answerback capability. In addition to the standard dialpad, adjacent fixed function buttons and the four programmable function buttons in the row above the dialpad.

The 16 Button set cannot accept a data card or a 36 button Add-on unit.

6.5.2 Four Button set

The Four Button set (See Figure 6-6) has the standard dialpad and adjacent fixed function buttons and four programmable buttons with dual color LEDs in the row above the dialpad. The Four Button set allows the user to access all the system features by pressing the **[FEAT]** button and dialing the feature code. The set has handsfree answerback capability.

The Four Button set cannot accept a data card or a 36 button Add-on unit.

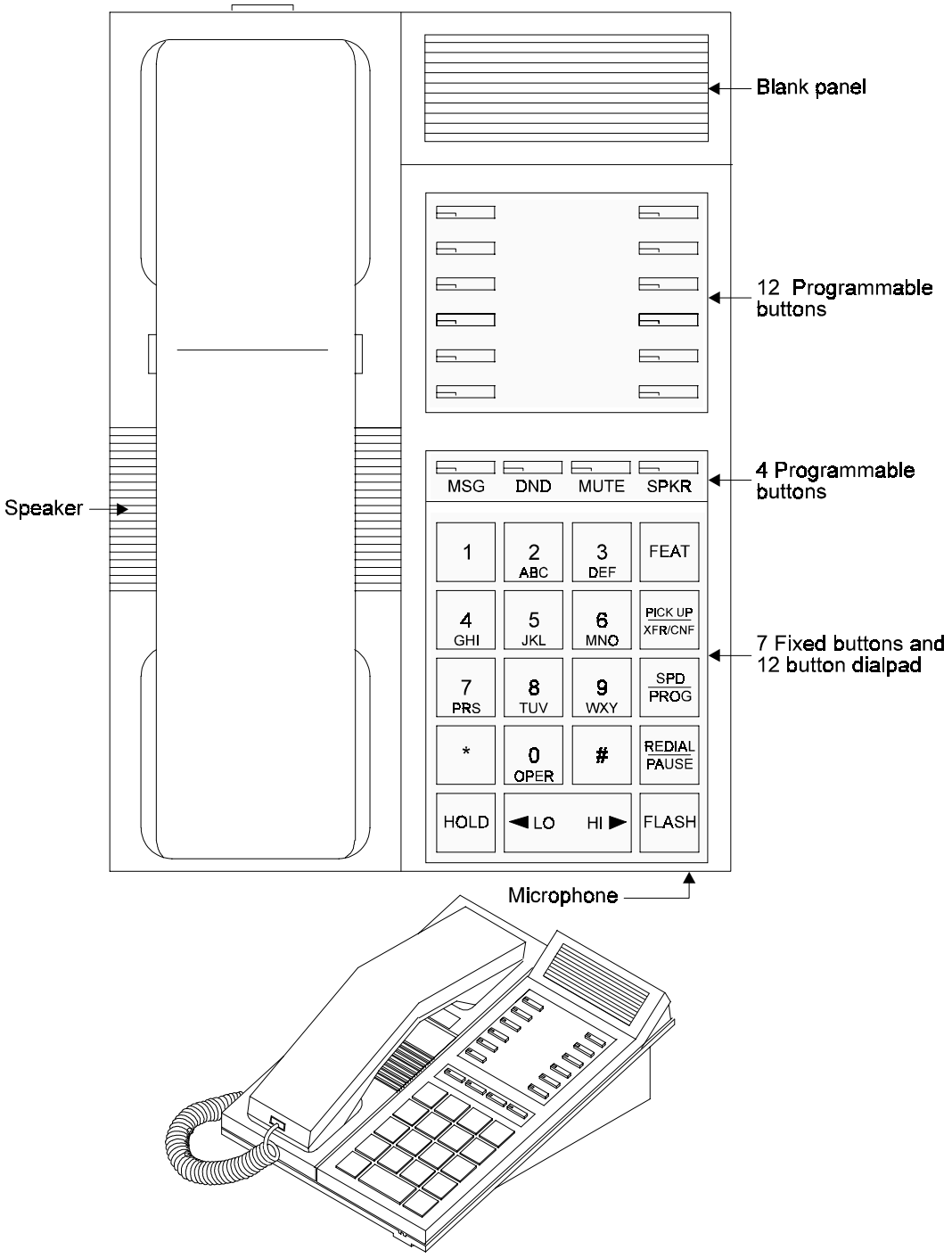


Figure 6-5 16 Button set

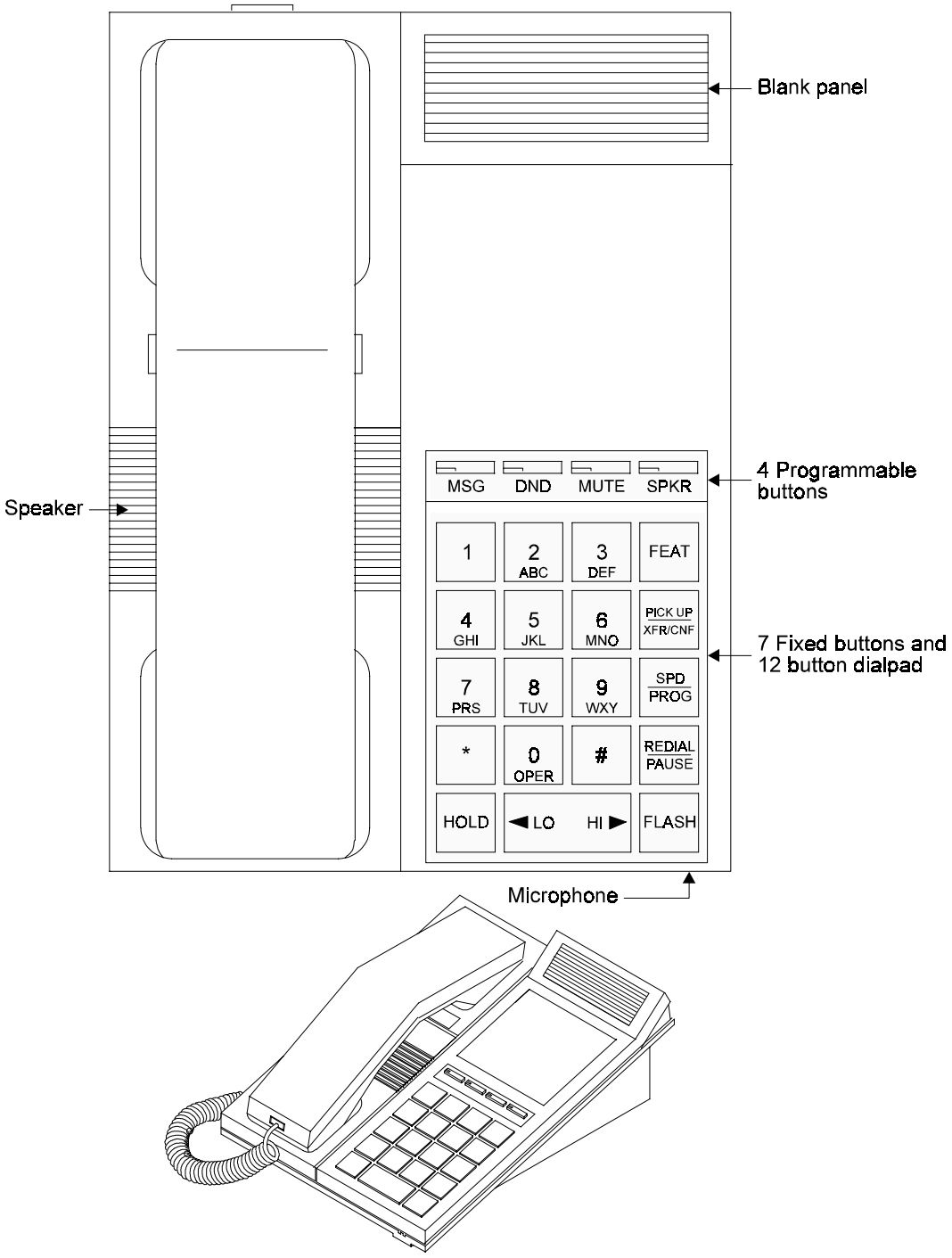


Figure 6-6 Four Button set

6.6 THE ANALOG FAMILY TELEPHONE SETS

In addition to the proprietary telephone sets created expressly for the DIGITAL systems, the systems support operation of four types of proprietary analog stations, as follows:

- Executive Station;
- Standard Display Station;
- Basic Key Set (with or without speakerphone;
- Four Button Plus Station (with or without speakerphone).

6.6.1 The analog family Executive station

The analog family Executive station is a multibutton, microprocessor based, telephone featuring two Liquid Crystal Displays (LCDs) and full speakerphone capability (See Figure 6-7). The Executive station can handle two conversations, using both the audio path and the handsfree path, simultaneously.

The station faceplate is divided into three zones:

- horizontal display with adjoining buttons;
- vertical display with adjoining buttons;
- dial pad with adjoining buttons.

Above the horizontal display is a row of eight programmable buttons and below the display is a row of eight fixed feature buttons.

Alongside the vertical display are two columns of eight programmable buttons, one column on each side.

The programmable buttons can be programmed for direct selection of extensions, outside lines, outside line groups, features or activation of speed dialing.

The horizontal display (LCD) provides call information such as type of call, caller identification, and elapsed call time. When the station is not in use, the display shows the time, date, as well as messages or message information.

When a call handling function button is pressed, an arrow indicator appears on the adjoining display to show that it is active. Indicators also show which of the external lines, selected by the adjoining button, is free, in use, or on hold.

The dialpad is used in the same way as a regular pushbutton telephone. Six function buttons for various dialing features, and two buttons for volume adjustment are on the dial pad as well.

A microphone is located at the front right of the station base and a speaker located under the handset for handsfree answerback calls. A directory tray for listing numbers and codes can be slid out from the underside of the station set.

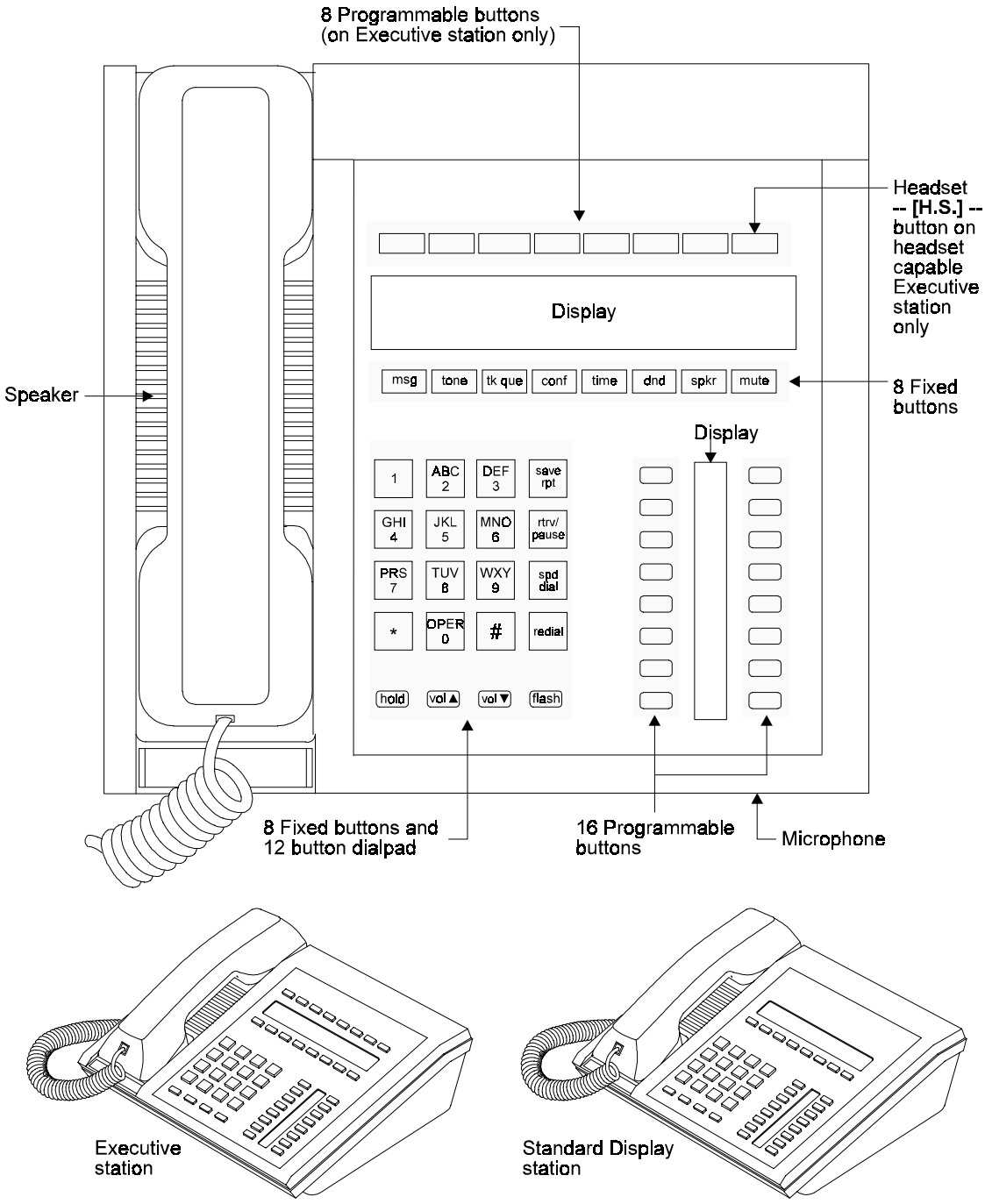


Figure 6-7 Executive station and Standard Display station

A special headset capable Executive station is available for connection of a headset, as well as a handset. The faceplate and functions of this telephone set are identical to those of the analog family Executive station, with the following two exceptions:

- a customer supplied headset can be connected, in addition to the standard handset;
- a fixed function headset button labeled **[H.S.]** -- the button on the right end of the eight button row above the horizontal display -- is used to activate and deactivate the headset.

6.6.2 The analog family Standard display station

The analog family Standard display stationis similar to the Executive station except that it has no buttons above the main display.

6.6.3 The analog family Basic key set

The analog family Basic Key Set is available either with or without the speakerphone capability found in the Executive Station and Standard display stations. It also differs from those stations due to its flip-lid note box in place of a horizontal display and buttons. (See Figure 6-8)

The two button columns each contain ten buttons. The top eight buttons in each column are user programmable and the bottom two are fixed feature buttons.

As a consequence of these differences, not all the functions available on the Executive Station and Standard display stations are available on Basic Key Sets . A directory tray for listing numbers and codes can be slid out from the underside of the station set.

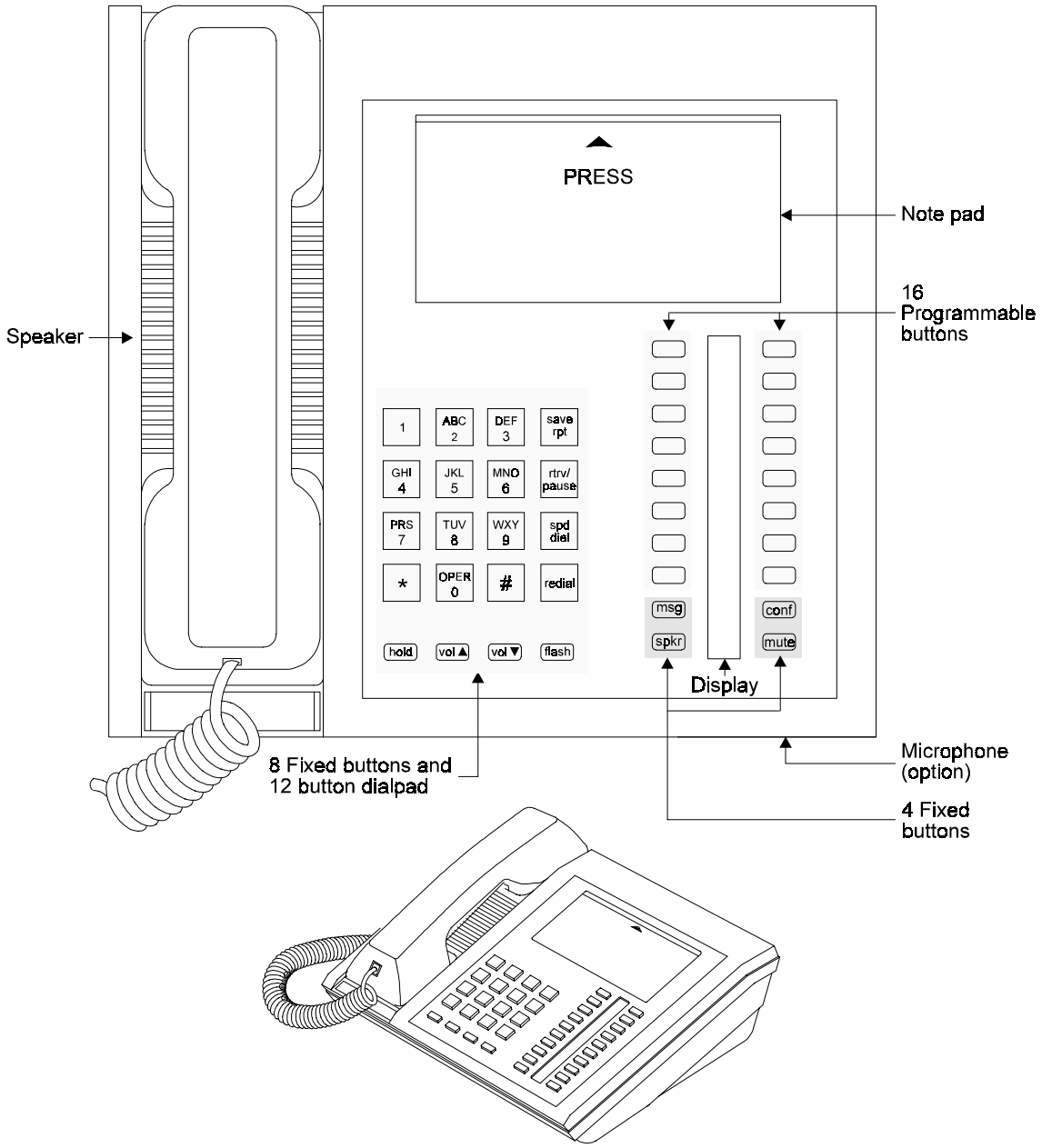


Figure 6-8 Basic Key Set

6.6.4 The analog family Four-button plus telephone set

The analog family Four Button Plus is equipped with a dialpad and two four-button rows of dedicated feature buttons. One four-button row of user programmable buttons is available for outside lines, features, speed dialing and paging. (See Figure 6-9).

Each button in the three four-button rows has a light emitting diode (LED).

The Four Button Plus telephone set is available with and without speakerphone capacity.

On a Four Button Plus telephone set with speakerphone, the mute feature can be activated during handsfree operation by pressing both the **[vol ↑]** and **[vol↓]** buttons simultaneously. This allows the user to disable the microphone, consult privately, and then enable the microphone again.

6.7 SINGLE LINE TELEPHONE (SLT)

The system is also compatible with most industry-standard, impulse dial or DTMF Single Line Telephone (SLT) sets, which are supported by the DIGITAL system's special software for enhanced operation.

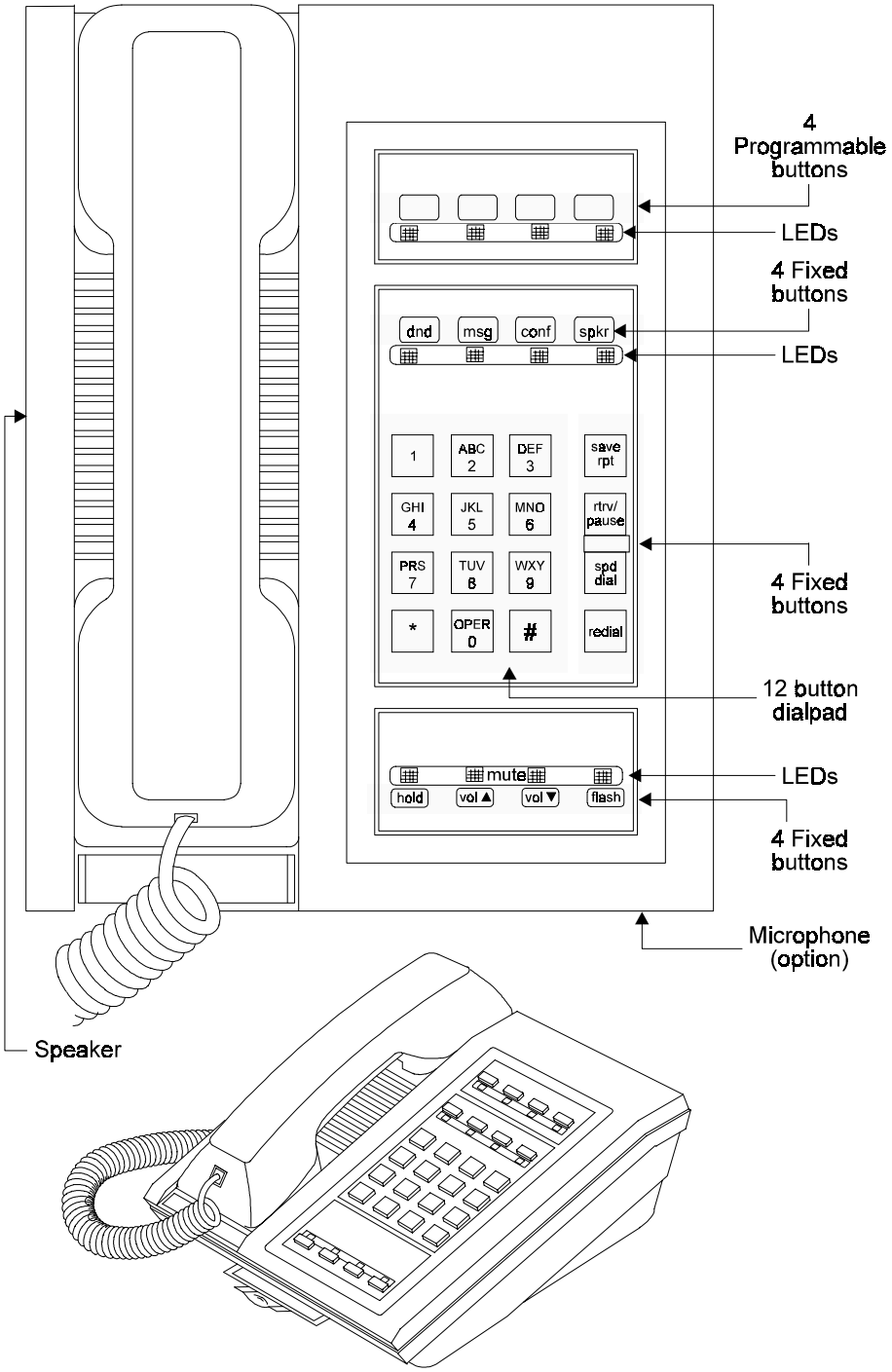


Figure 6-9 Four button plus

6.8 TELRAD TRACKER

The Telrad Tracker Set operates with the family of systems as a custom-designed portable telephone extension. Aside from the standard dialpad, it has four fixed feature buttons and four PC-programmed buttons. It also includes a 2-by-16 character display, volume control button, 30-channel selector button and a jack for an optional headset. From a functional viewpoint, it can perform most of the features available to an set with display, with a few exceptions, including: receiving a page, handsfree answerback, background music and call intrusion.

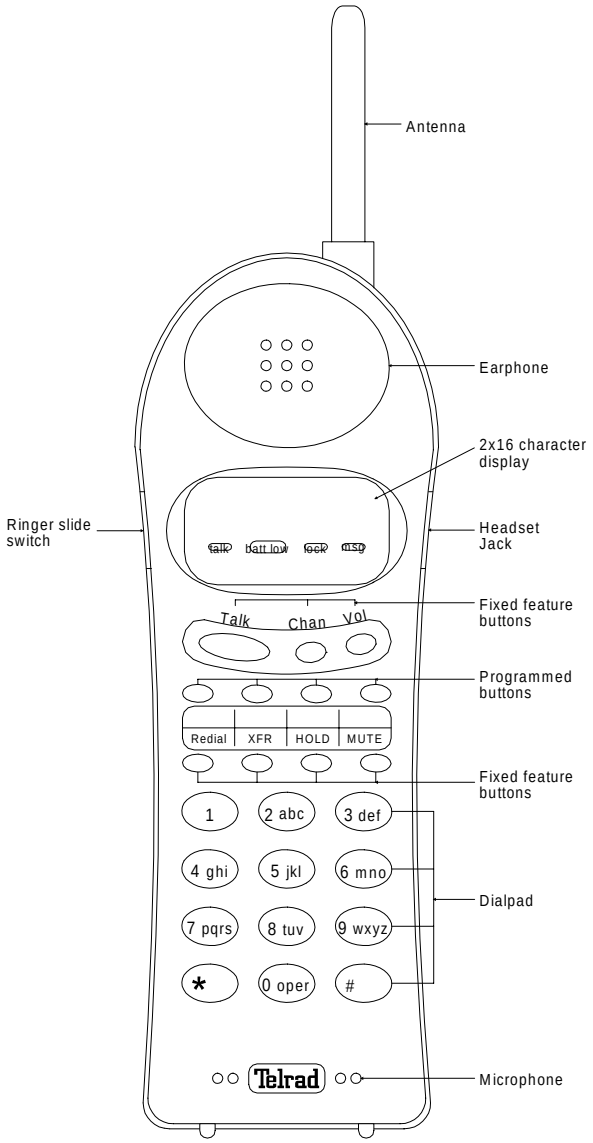


Figure 6-10 The Telrad Tracker

6.9 THE ATTENDANT CONSOLE

The Attendant console (See Figure 6-11) is a multibutton digital telephone set offering an expanded display for soft button operation. Single channel Universal data card and TAPI/TelradLINK data card installed in this telephone set perform protocol conversion. This enables a PC to connect to the DIGITAL system and operate with appropriate Telrad Console, CSD, TAPI, TSAPI, TelradLINK, CSV, or ACD I.Q. software.

Though the Attendant console is physically similar to the Executive set with expanded display (See Section 6.2.2 above), its programmable button and softkey designations are specially suited to attendant functions.

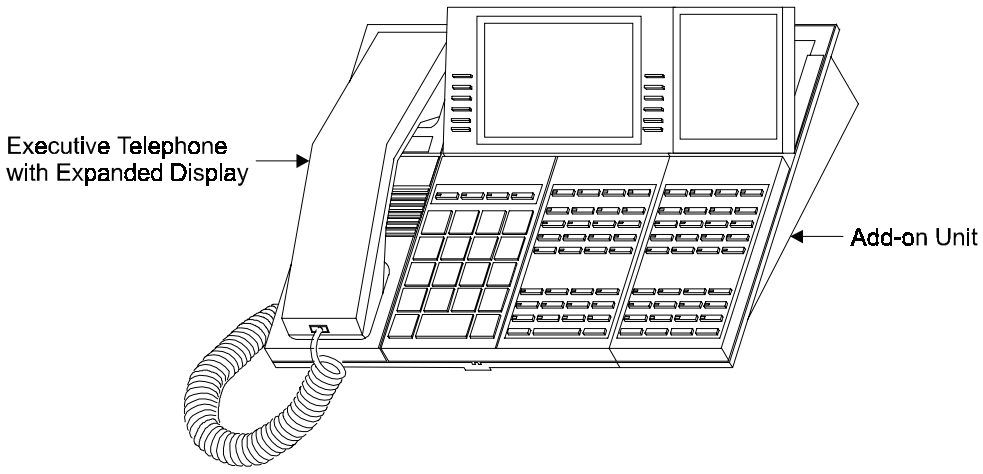


Figure 6-11 Attendant console with 36 Button Add-on unit

In addition to the standard 12-button dialpad, the Attendant console features 21 fixed function buttons, 25 programmable buttons with dual-color LEDs, six menu-driven softkeys, and six Private Hold softkeys.

An eight line by 24 character dot matrix, LCD provides two rows of information (time, date, call progress indications, etc.) and software controlled prompts for the six softkeys.

Softkeys change their function dynamically, depending on the current status of a call. More than 30 features can be operated by just six softkeys. In addition, softkeys simplify the console operation by showing all the currently valid options. Features not currently applicable are not displayed.

The Attendant console can be enhanced further by attaching it up to four 36 button Add-on units (See Figure 6-11 and Figure 6-12).

The DIGITAL systems provide the attendant with the capabilities and sophistication of a PBX. With the aid of programmed logical queues, softkey operation, an expanded display and 36 button Add-on units, the attendant can handle large call traffic volumes. The attendant also performs various maintenance functions.

6.9.1 Call queues

A DIGITAL system is divided into up to four logical (tenant) groups. Each group has twelve First-In-First-Out (FIFO) call queues, controlled by the attendant, for selective handling and equal sharing of call traffic.

To ensure that calls are not dropped, all callers reaching the attendant hear ringback tone, and enter a Main Call queue. In addition, incoming calls on privileged outside lines or internal extensions can enter one of eight Incoming Call Identifier (ICI) queues. Interposition calls, recalls and personal recalls also enter special queues. Each queue has an appearance at the attendant console. The attendant knows the source of any call ringing at the console and can give priority to calls from managers or important users, or to calls which have been on hold for a long time.

6.9.2 Maintenance

The attendant is informed in the Attendant console display of alarm messages generated by DIGITAL system diagnostics, unless alarms are programmed not to be displayed. In addition, the attendant can test ports and outside lines to see if they are noisy or busy. To prevent overloading the memory buffers, the attendant can also cancel all system messages.

The attendant has a wide array of fixed buttons for performing attendant functions, maintenance procedures, and regular DIGITAL system activities.

6.10 THE TELRAD CONSOLE

The Telrad Console provides an optional alternative for operating the attendant position on the Executive Set without Display. The DIGITAL personal computer based Telrad Console attendant position provides the features of the telephone set attendant console with the added convenience, greater flexibility and ease of use found in a full PC screen. In addition to the call processing features, the Telrad Console provides a directory feature, notes feature and many other valuable enhancements, including the following:

- Additional speed in call processing;
- Called party location and forwarding to pagers, cellular phones, alternate telephone numbers;
- Dial from notes;
- Directories;
- Enhanced message taking;
- Expanded speed dialing capabilities;
- Expanded display with call status information;
- Note writing;
- Separate greeting messages appear for calls on each trunk.

6.11 THE 36 BUTTON ADD-ON UNIT

The 36 button Add-on unit is a separate unit which can be attached to Executive and Display Speakerphone digital telephone sets or an Attendant console. It provides 32 additional programmable buttons which can be used for Direct Station Selection and speed dial numbers. Each button is equipped with a dual-color LED status indicator. The function of the buttons on the 36 button Add-on unit is determined in system programming. (See Figure 6-12.)

The 36 button Add-on unit utilizes the D channel on the S bus. Up to four units can be added to an Executive or Display Speakerphone set or to an Attendant console. The first Add-on unit connected to a digital set or an Attendant console draws power from the telephone set to which it is connected. It is, however, counted as one of the following:

- 32 power ports, supported by the DIGITAL KEY BX system cabinet;
- 96 power ports, supported by the DIGITAL 400 system cabinet.

These can be supported by the system cabinet to which that set is connected. The second, third and fourth units attached to a single station require one external power transformer which is plugged into an AC source and do not require system ports.

Each Add-on unit supports up to four multiple appearance (MAPs) in the DIGITAL KEY BX system, and up to eight MAPS in the DIGITAL 400 system. This defines the function of each of the unit's 36 buttons.

The DIGITAL KEY BX system supports a maximum of eight 36 button Add-on units.

The DIGITAL 400 system supports a maximum of sixteen 36 button Add-on units.

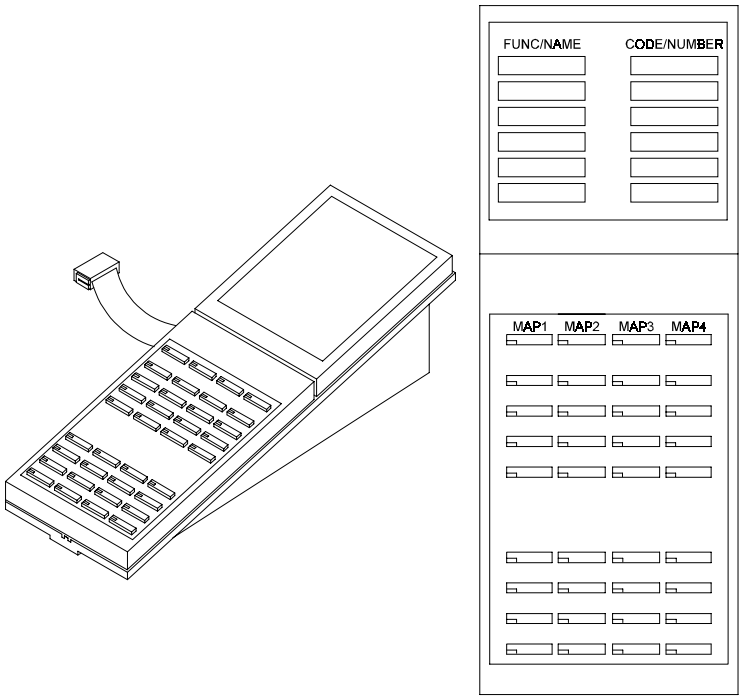


Figure 6-12 36 button Add-on unit

6.12 UNIVERSAL DATA INTERFACE (UDI) CARD

The Universal Data Interface card can be installed internally in any of the Executive or Speakerphone telephone sets or Attendant Console.

The UDI card performs protocol conversion serving as a multifunctional interface between the DIGITAL system and terminal equipment. This enables a connected PC to operate with the appropriate software required for each application.

The UDI card supports Circuit Switched Voice, Circuit Switched Data and Basic TAPI applications. The UDI card is installed in the DIGITAL telephone sets and integrates with the PC via the UDI card's RS232 interface. (See the DIGITAL Installation Manual).

NOTE

Although most software using extended Hayes modem signals is compatible with basic TAPI, Telrad does not guarantee that any software will be completely compatible with Telrad's UDI card in a system. It is the responsibility of the installing dealer or system integrator to check and test software compatibility with the Universal Data Interface Card.

6.13 TELRADLINK DATA CARD

The TelradLINK Data card supports Circuit Switched Voice and Extended TAPI applications. The TelradLINK Data card also supports custom written applications using the TelradLINK protocol. The TelradLINK Data card is installed in the DIGITAL telephone sets and integrates with the PC via the data card's RS232 interface. Refer to the TAPI/ TelradLINK Installation and Programming manual for a detailed explanation of the procedure for connecting TAPI/ TelradLINK to a DIGITAL KEY BX system or DIGITAL 400 system.

6.14 TSAPI (TELEPHONY SERVICES APPLICATION PROGRAMMING INTERFACE)

TSAPI provides a system level computer telephony interface between the DIGITAL system and a network server for third part call control. Refer to the TSAPI SPI Guide for Application Developers for a detailed explanation of the procedure for connecting TSAPI to a DIGITAL KEY BX system or DIGITAL 400 system.

6.15 VOICE RECOGNITION CARD

The optional Voice Recognition card supports up to 56 telephone numbers, each one being up to 32 digits in length. With this card, the user can dial these numbers automatically by voice command.

The Voice Recognition card can be installed internally in any of the following DIGITAL telephone sets:

- Executive Set with Expanded Display;
- Executive Set with Display;
- Executive Set without Display;
- Display Speakerphone Set.

See Voice Dialing Kit: Installation Guide for additional details.

Section 7
SYSTEM WIRING CONNECTIONS

7.1 GENERAL

This section provides general information on the DIGITAL wiring connections. For more information, see the DIGITAL family of systems Installation manual.

Main Distribution Frame (MDF) connection

The Main Distribution Frame is connected to the DIGITAL system cabinet by 25-pair cables fitted with 25-pair "Amp-champ" male connectors. The MDF is not supplied by Telrad.

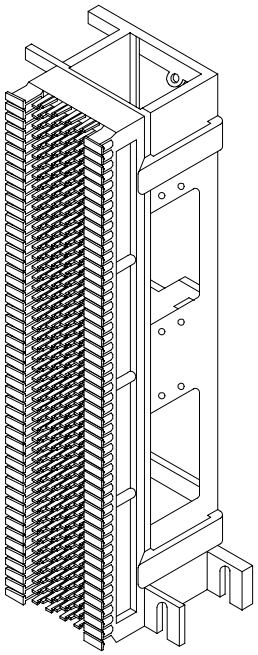


Figure 7-1 Main Distribution Frame block

7.2 TELEPHONE SET CONNECTION

All telephone sets are connected to the MDF via modular junction boxes. The junction boxes are connected to the MDF using two or three-pair crossconnect or covered wire (24 AWG). The telephone sets are connected to the junction boxes using standard 4-wire telephone cables. The exception is analog sets, which use 6-wire telephone cables, terminated at each end by RJ11 connectors. For details of junction box wiring and S-bus installation, see the DIGITAL Family of Systems Installation manual.

7.3 PERSONAL COMPUTER TO SYSTEM CONNECTION

A personal computer (PC) for system administration is connected to the MPD card, in the system cabinet, using an RS-232 cable terminated by an RJ45 connector.

Personal computers can be connected to a data card installed in a digital telephone set.

7.4 PRINTER TO CARD CONNECTION

A printer can be connected, using a standard serial interface cable, to the RJ45 RS-232 connector on one of the following:

- an MPD, COG, COL, CHL, RS-232 or OCD card;
- an RS-232 daughterboard mounted on an ONS and HONS card.

7.5 EXTERNAL MODEM CONNECTION

An external modem can be connected to the system. The modem is connected to an SLD or SHD card, via the MDF and a junction box. The modem to junction box cable is a standard four wire telephone cable terminated at both ends by RJ11 connectors.

THIS PAGE INTENTIONALLY LEFT BLANK

Section 8
CONFIGURATION

8.1 TELEPHONE SET CONFIGURATIONS

The proprietary digital and analog telephone sets can be configured in a number of ways. The configuration is determined by both the physical installation and the software definition as programmed in system administration.

A maximum wire length of 33 feet (10 meters) is used between a junction box and its associated telephone set.

8.1.1 Audio path port utilization alternatives for digital sets

- Single Audio Path (SAP);
  The Single Audio Path (SAP) configuration is standard and supports the connection of two digital telephone sets on the same line (S bus).

  A digital telephone set or other terminal element (TE) connected in a SAP configuration utilizes one extension port and one power port.

- Dual Audio Path (DAP);
  If the Dual Audio Path (DAP) configuration is adopted, only one digital telephone set can be connected to each S bus. Each telephone on a line is connected by means of a junction box.

  A digital telephone set or other terminal element (TE) connected in a DAP configuration utilizes two extension ports and one power port.

- Universal data interface (UDI);
  A Universal data interface (UDI) card, when installed in a

digital telephone set, utilizes an additional extension port and an additional power port for CSD mode only.

8.1.2 Passive Bus configuration alternatives for digital sets

The various possibilities for connecting digital telephone sets are described below.

- Long Passive Bus configuration;
  This configuration supports the following options:

  - Connection of one telephone set at a distance not exceeding 3000 feet (900 meters) from the cabinet (See Figure 8.1a);
  - Connection of two telephone sets, the first at a distance not exceeding 820 feet (250 meters) from the cabinet, and the second up to 165 feet (50 meters) from the first (See Figure 8-1b).

- Short Passive Bus configuration:
  This configuration is used for the connection of two telephone sets, each at a maximum distance of 360 feet (110 meters) from the cabinet (See Figure 8-1c).

8.1.3 Critical distances of analog telephone sets and SLTs

The maximum distance of analog telephone sets and SLTs from the system cabinet are as follows:

- Analog set (connected to ELA card) 2400 feet (800 m);
- SLT (connected to SLD/SHD card) 3.75 miles (6 km);
- SLT (connected to ONS/HONS card) 1.5 miles (2.5 km).

8.2 DATA TERMINAL ELEMENT (DTE) CONFIGURATIONS

To facilitate Circuit Switched Data (CSD) transmission between various DTE elements as well as between DTE elements and DCE modems, configure the UDI for Data terminal equipment elements (such as PCs, other computers, dumb terminals, modems and printers) with DIGITAL system Executive or Display Speakerphone telephone sets. The configuration is determined by both the physical installation and the software definition as programmed in system administration.

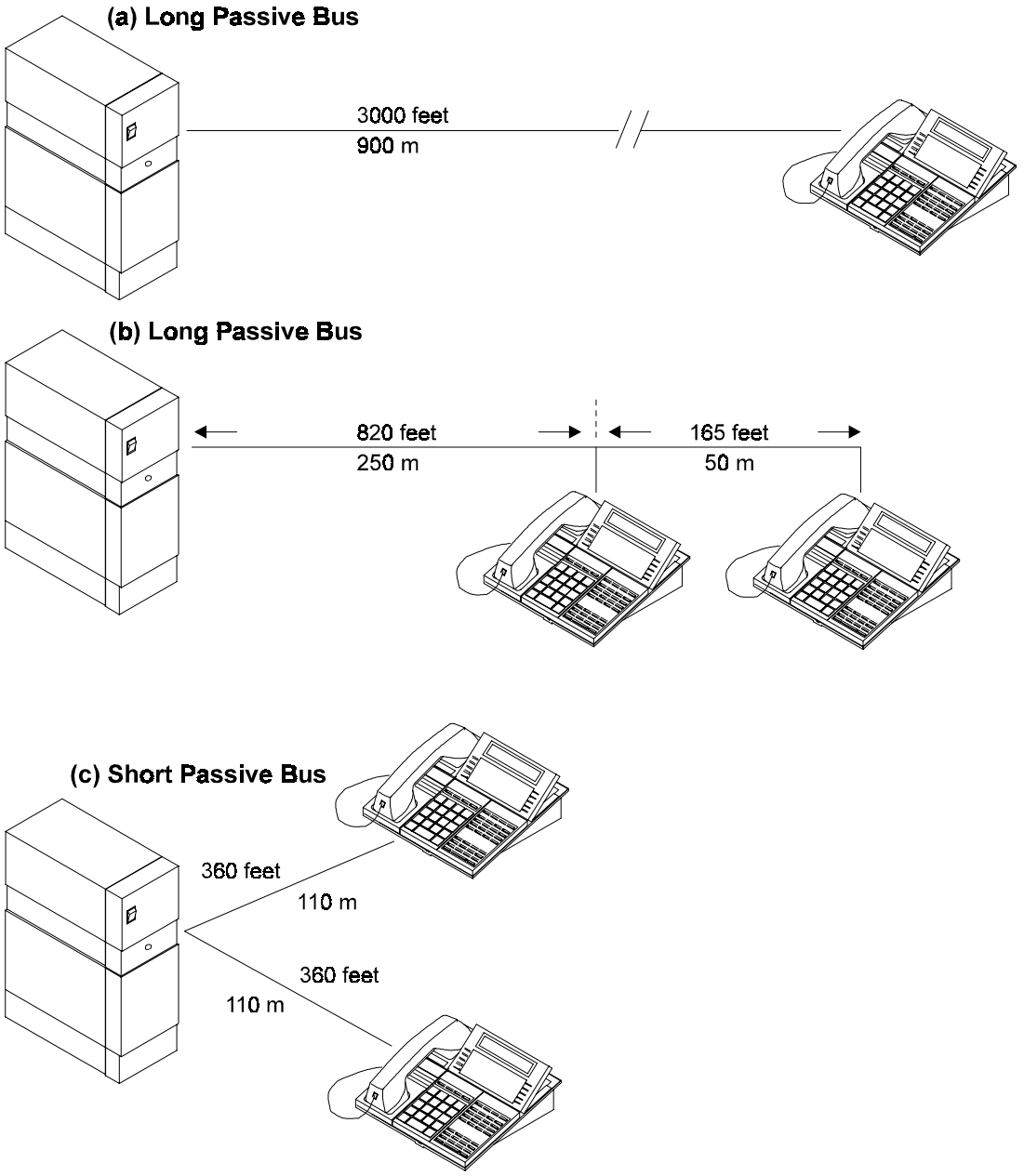


Figure 8-1 Passive bus configurations

In order to utilize CSD, each DTE element must be:

- defined for Single Audio Path (SAP) configuration;
- connected to a telephone set defined for Single Audio Path (SAP) configuration on the same S bus.

Circuit switched data communication is carried out on one of the two 64 Kb B audio channels of the S bus. This provides a data channel operating at up to 56 Kb per second, synchronous, or

up to 38.4 Kb per second, asynchronous. Its communication rate is adapted according to the V.110 rate adaptation protocol.

Utilizing telephone lines and/or T1/E1 carriers, this approach eliminates the need for additional interconnecting computer- to-computer cabling within a DIGITAL system, as well as between DIGITAL systems. This allows both local and remote communication among DTE elements, host computers, local area networks (LANs), via SAP DIGITAL system telephone sets equipped with universal data cards.

8.2.1 Terminal to host configuration alternative

This configuration (See Figure 8-2) supports the connection of a host computer to one SAP telephone set.

The DTE elements can be programmed and connected for one of the following:

- direct hotline mode communication, at any time, with the host computer;
- command mode communication, when required.

8.2.2 Modem pool configuration alternative

This configuration supports incoming and outgoing communication between one, or a series of, DTE elements and a host computer within a DIGITAL system and DTE elements outside the system. (See Figure 8-2b below.)

The internal/external communication is completed via:

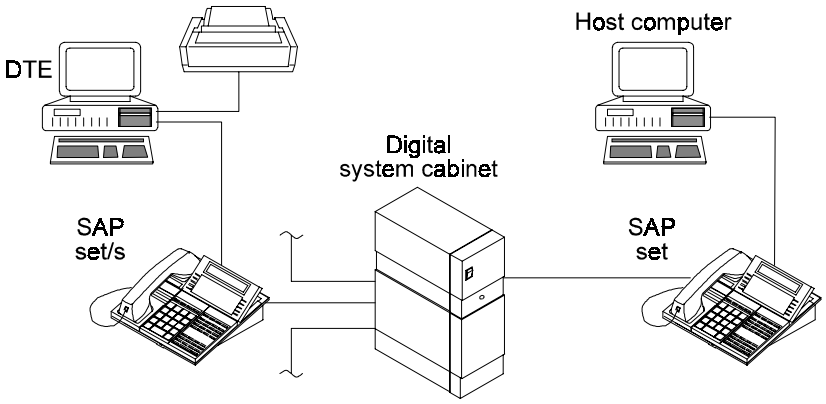
- the Central Office via a single modem, or modem pool, connected to SAP telephone sets within the DIGITAL system;
- another modem connected to the remote external DTE element.

Outgoing communication can be established by one of the following:

- an internal DTE element;
- the host computer via the pooled SAP sets to which one or more standard standalone DCE modems are connected.

Incoming communication is established by an external DTE element equipped with a modem, via pooled SAP sets to which DCE modems are connected. Modems can be connected via SLT ports or via Central Office lines.

(a) Terminal to host configuration



(b) Modem pool configuration

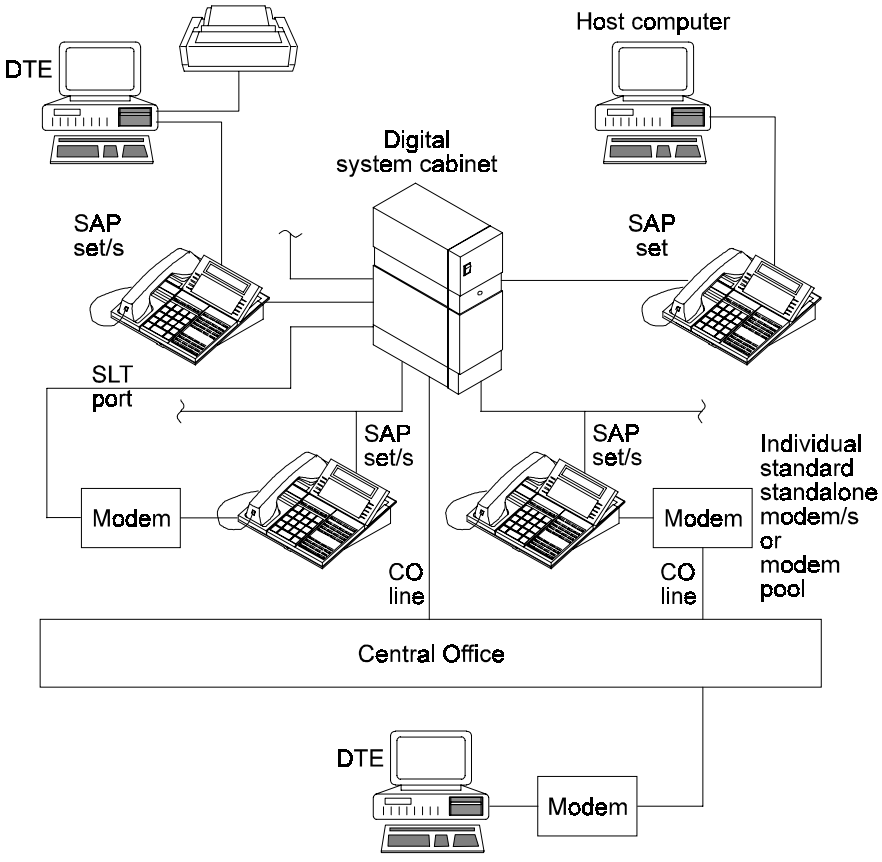


Figure 8-2 Terminal to host and modem pool CSD configuration alternatives

A DCE element equipped with a modem can be programmed for incoming calls, for one of the following:

- direct hotline mode communication, at any time;

- command mode communication, when required, with either an internal DTE element, or a group of DTE elements.

The CSD configuration and profiles are entered by running an installation program on a PC which is connected directly to one of the CSD stations. The CSD programming for the entire system can be done from one CSD station.

8.2.3 T1/E1 carrier configuration alternative

This configuration (See Figure 8-3, below) supports incoming and outgoing communication between the various elements within one DIGITAL system and those in another DIGITAL system connected, via a Central Office provided digital T1/E1 carrier path. The internal/external communication is completed via the Central Office utilizing a digital path comprised of one of the following:

- a T1/E1card in each of the DIGITAL systems;
- a digital path link between the digital carrier channels of the two DIGITAL systems, provided by the Central Office.

In this configuration, DTE elements can be programmed and connected for one of the following:

- direct hotline mode communication, at any time;
- command mode communication, when required, for communication with local system or remote system elements, including any of the following:

    - host computers;

    - DTE element directly connected via SAP telephone sets to one of the DIGITAL systems, or connected via a LAN connected to a SAP telephone set to one of the DIGITAL systems.

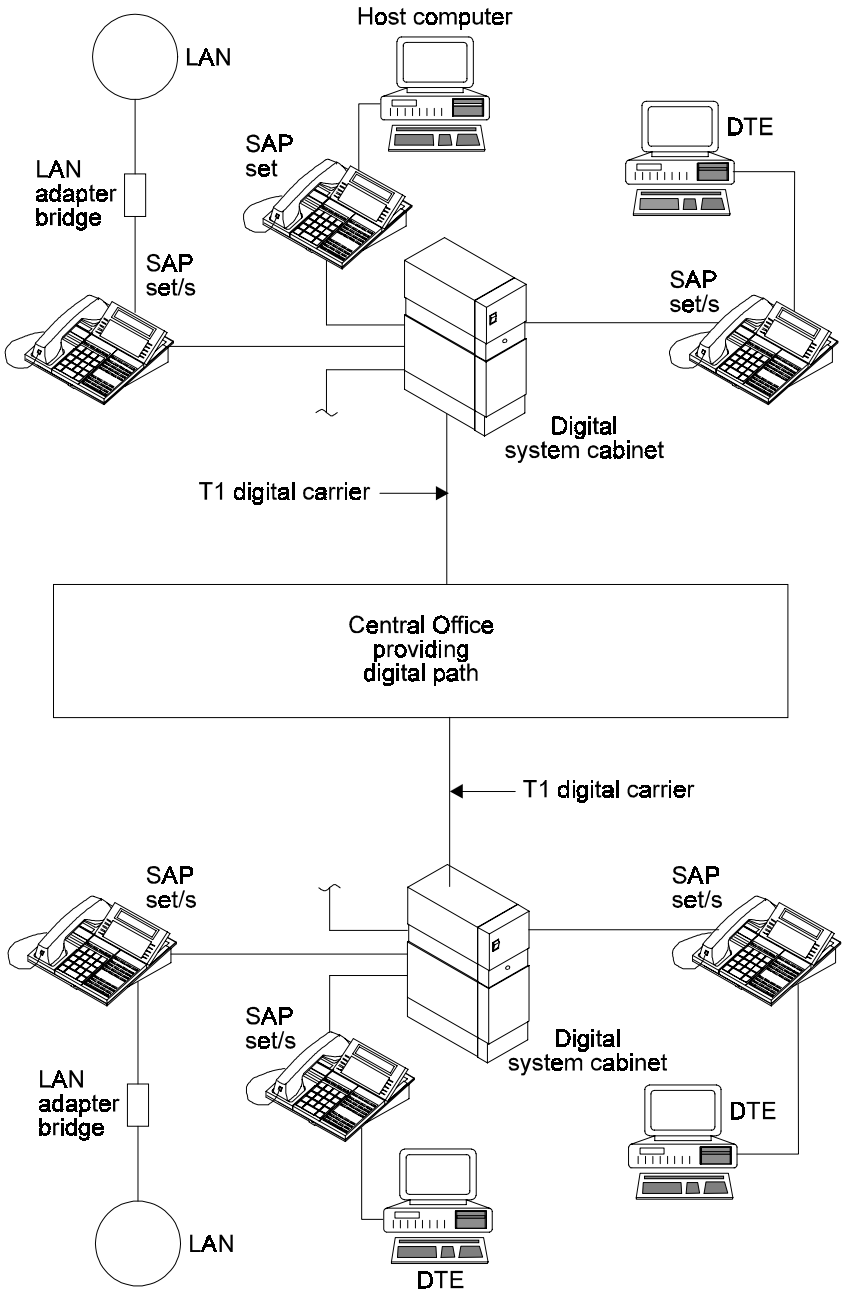


Figure 8-3 T1/E1 carrier connected network CSD configuration alternative

The following steps are required to plan and configure a DIGITAL system:

1. Define user requirements.
2. Design user floor plan.
3. Transfer the data to programming forms.
4. Transfer the configuration data to a personal computer.
5. Install the hardware according to the software configuration.
6. Restore the configuration from either a remote computer, or a local PC, to the DIGITAL system.

Section 9
EXTERNAL EQUIPMENT

9.1 GENERAL

This section describes external equipment connections available for use with the DIGITAL family of systems. It also details hardware requirements and configuration parameters relevant for provisioning, planning, and installation of external equipment.

9.1.1 The IMAGEN (Integrated Multi-Application Generator)

The IMAGEN (Integrated Multi-Application Generator) is an advanced, personal computer based call answering system providing automated attendant and voice mail facilities and an integrated application generator (optional). IMAGEN serves both internal and external callers using DTMF signaling and impulse dial telephone. The automated attendant feature provides callers with recorded messages, including information about the called company and its hours of business, together with instructions for using IMAGEN voice mail. IMAGEN is menu-driven and easy to operate.

NOTE

Each IMAGEN port is counted as one of a maximum of 96 extension ports which can be supported by a DIGITAL KEY BX system.

Each IMAGEN port is counted as one of a maximum of 254 extension ports which can be supported by the DIGITAL 400 system.

9.1.2 The IMAGEN-PC

The IMAGEN system is based on a dedicated personal computer, termed the IMAGEN-PC, fitted with additional proprietary printed circuit cards.

The IMAGEN system normally includes the IMAGEN-PC with the proprietary IMAGEN cards and already installed software.

To connect the IMAGEN voice mail option, the personal computer with the voice mail cards must be connected to an OCD card. In a wheel mounted DIGITAL 400 system, the computer power cord can be plugged into one of the sockets on the power strip.

NOTE

Once IMAGEN has been installed, you cannot use any other non-proprietary voice mail systems within the DIGITAL system.

9.1.3 The IMAGEN Voice Mail Card

The IMAGEN Voice Mail card is the main interface card between the DIGITAL exchange and the PC for supporting voice mail, Integrated Station Message Detail Recording (ISMDR) and Electronic Business Card (EBC) applications. IMAGEN software is designed to handle up to four proprietary IMAGEN cards, each providing up to four IMAGEN ports. Cards are denoted in programming as cards 1 through 4 for port assignment purposes.

These cards come in two models:

- DVC which provides four IMAGEN channels plus data support;
- DVC Expansion card, which provides four IMAGEN channels, but no data support.

Each system requires at least one DVC card. A smaller capacity, two port IMAGEN card is available to run IMAGEN in a DIGITAL KEY BX system in which two IMAGEN ports are considered adequate.

The IMAGEN-PC can hold any of the following configurations of IMAGEN printed circuit cards:

- A single two-port card, for a two-port IMAGEN system;
- One four-port card, for a four-port IMAGEN system;
- One four-port and one two-port cards for a six-port system;
- Two four-port and one two-port cards for ten-port system;

- Two four-port cards, for an eight-port IMAGEN system;
- Three four-port cards, for a 12-port IMAGEN system;
- Four four-port cards, for a 16-port IMAGEN system.

The four card/16-port configuration is only possible with a DIGITAL 400 system.

The IMAGEN cards are connected to OCD cards installed in the DIGITAL KEY BX or DIGITAL 400 system cabinet.

9.1.4 OCD card in the system cabinet

The required audio and data connections are made between IMAGEN cards in the IMAGEN-PC and OCD cards in the DIGITAL KEY BX or DIGITAL 400 system cabinet. These connections consist of the following:

- Data connection: from the first IMAGEN card via a three-wire cable to the RJ45 connector on the outside edge of the first OCD card holding MIMs. A similar cable must be connected to a second OCD card, which contains one or more MIM modules supporting IMAGEN ports.
- Audio connection: from each IMAGEN-PC card, via a four-pair cable to a junction box and the MDF, and via a 25-pair cable from the MDF to the 25-pair connector on the outside edge of the OCD cards.

NOTE

A 16 port IMAGEN configuration must use two OCD cards. A configuration of more than four ports may use two OCD cards for improved system performance.

Figure 9-1 shows the physical connections between an IMAGEN card and the DIGITAL KEY BX or DIGITAL 400 system.

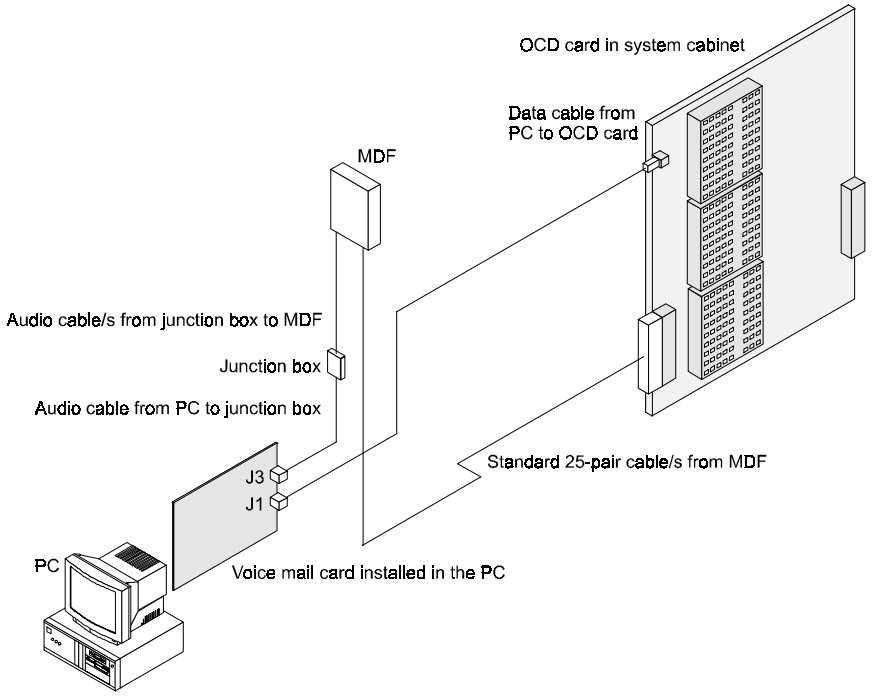


Figure 9-1 IMAGEN connections with the DIGITAL system

Application Generator

The Application Generator is an optional software package, which provides a Windows based development environment for defining IMAGEN Auto Attendant menus. Menu items can be redefined, by selecting from a list of operations, or a number of operation steps can be combined to create a "chain" for a single menu item. Using the Application Generator, your IMAGEN can be customized to suit the particular requirements of your organization.

By means of Application Generator programming, guest messages can be allowed for non-system users, giving them temporary voice mail access (using a password, if necessary) so they can leave and receive messages.

For further information on the IMAGEN multi-application generator system, and its integration with DIGITAL systems, refer to the IMAGEN System manual.

9.2 ISMDR (INTEGRATED SYSTEM MESSAGE DETAIL RECORDING)

ISMDR is the call accounting program option integrated with the IMAGEN multi-application generator system and the DIGITAL system. It provides a powerful tool for review and control of its telephone utilization and costs.

With ISMDR, you can program and receive either detail or summary reports of calls and their cost, as well as have them sorted, or unsorted, with respect to the following:

- extensions;
- outside lines;
- dialed numbers;
- account numbers;
- caller identification and calling line identification;
- destination prefixes -- area code or local office;
- call duration;
- a variety of other parameters.

Reports covering a wide range of alternative selected time periods and other call characteristics can then be viewed, either on the IMAGEN-PC screen or in report printouts.

All ISMDR programming tasks can be carried out from the IMAGEN-PC keyboard, during uninterrupted real time operation of IMAGEN.

NOTE

Compliance with local telephone company or other regulations that may be involved in modification of rates and using updated rates in ISMDR is the responsibility of the customer, exclusively. Telrad accepts no responsibility in this regard.

For further information on ISMDR, and its integration with the DIGITAL system, refer to the ISMDR manual.

9.2.1 IMAGEN Installation

The IMAGEN installation must be complete (including both hardware and software) as described in the IMAGEN System Manual for DIGITAL systems.

9.2.2 The Integrated SMDR Costing Diskette

The Integrated SMDR costing diskette must be loaded into the IMAGEN-PC before Integrated SMDR can operate. (The costing diskette is not provided by Telrad . The installation of

Telrad IMAGEN software is described fully in Section 5 of the System Manual.

9.2.3 Integrated SMDR Protection Plug

The Integrated SMDR protection plug must be plugged into the IMAGEN-PC before the Integrated SMDR can operate.

With the Integrated SMDR protection plug installed, the system saves all recorded call accounting data for the current month, as well as the past 12 months. You can order reports covering any selected part of the corresponding time period.

Without the Integrated SMDR protection plug installed, the system will not produce Integrated SMDR reports, save Integrated SMDR records, or provide any cost data whatsoever. Although you will be able to view the on line call monitor, the cost column will not appear there.

If a parallel printer is to be used with Integrated SMDR, it is essential that the printer be plugged into the Integrated SMDR protection plug.

The Integrated SMDR protection plug (shown below in Figure 9-2) has a male DB25 connector on one end, and a female DB25 connector on the other.

NOTE

The IMAGEN PC should be turned off when installing the integrated SMDR protection plug.

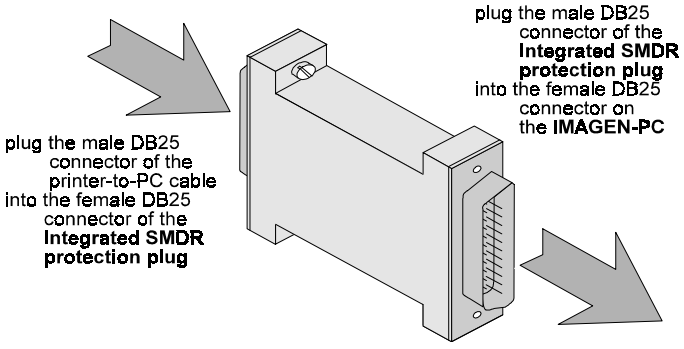


Figure 9-2 The Integrated SMDR protection plug

9.3 PERSONAL COMPUTER FOR SYSTEM PROGRAMMING

A personal computer (IBM PC, 286, 386, 486, Pentium or compatible) is required for configuring the DIGITAL system. The personal computer (PC) must be equipped with a minimum 640K RAM, a minimum 40 Mb hard disk and at least one serial communication port. The PC can be located at a remote site or next to the DIGITAL system on the customer's premises. All system administration can be carried out by the distributor locally, or from a remote site.

9.4 PRINTER

Any serial printer can be connected to the DIGITAL system to produce a detailed printed record of calls. The printer is connected to the RS-232 port on a COL, CHL, COG or RS-232 card or on an RS-232 daughterboard mounted on an ONS or HONS card.

9.5 EXTERNAL PAGING

The loudspeakers connected to the external paging channel on the MPD card, or to a Multiple Interface Module (MIM) on the Option card, must be terminated with a 600 ohm device.

A maximum of eight external page zones can be utilized in a DIGITAL system.

9.6 DOOR UNIT

The Door unit loudspeakers must be terminated with a 600 ohm device. The units must be no louder than 3 dBm. A maximum of four door units can be utilized in a DIGITAL system.

9.7 EXTERNAL BELLS

The DIGITAL system is designed to operate with industry standard external bells via relay dry contact closures.

9.8 EXTERNAL EQUIPMENT RELAYS

External relays for the operation of external paging, alarms or door unit electric locks, can be activated by the system.

9.9 EXTERNAL SWITCHES (SENSORS)

External switches are used with external equipment such as door unit bells or fire alarms. They must be normally open switches, push buttons, or relays. The system is able to detect switch operation.

9.10 AUDIO SOURCE FOR BACKGROUND MUSIC (BGM)

A music source, tape, radio, etc., can be connected to the BGM plug (RCA type) on the MPD card.

The same audio source can be shared by both BGM and MOH.

9.11 AUDIO SOURCE FOR MUSIC ON HOLD (MOH)

A music source, can be connected to the Audio Source plug (RCA type) on the MPD card instead of to the built-in MOH tone generator, which is on the MPD card.

The same audio source can be shared by both BGM and MOH.

9.12 ANNOUNCER

An industry standard SLT announcer can be connected to the system to provide information to callers reaching a busy extension or group of extensions. A maximum of 4 announcer ports are available per DIGITAL KEY BX system. A maximum of 8 announcer ports are available per DIGITAL 400 system.

9.13 HEADSET

9.13.1 Digital telephone set headset

A headset can be connected in place of a digital telephone set handset. The handset can be plugged into the headset control box which is provided with a switch, enabling the user to change activity from headset to handset. A headset button must be defined for the telephone set in system administration.

A headset can be chosen from the following Telrad approved models:

Manufacturer	Model	Switch position
GN Netcom	Multipurpose amplifier (MPA) with profile 3	system type: S2 phone type: E
Plantronics	Headset adapter with Supra	5
Plantronics	Headset adapter with Star Set	5

9.13.2 Analog telephone set headset

A special analog headset capable Executive station is available for connection of a customer supplied headset, as well as the standard handset. The faceplate and functions of this telephone set are identical to those of the Executive station, with the following two exceptions:

- a customer supplied headset can be connected -- in addition to the standard handset;
- a fixed function headset button labeled **[H.S.]** -- the button on the right end of the eight button row above the horizontal display -- is used to activate and deactivate the headset.

9.14 TELRADLINK DATA INTERFACE

TelradLINK is a hardware-firmware product that allows any of the Executive and Display Speakerphone telephone sets to operate extended TAPI applications via a personal computer. The telephone set must have the single channel TelradLINK data interface card installed.

9.15 MLX-82 CALLER IDENTIFICATION INTERFACE

Caller Identification can be received only on predefined analog outside lines, which are connected to a port on an MLX-82 caller identification interface. Each MLX-82 interface can support up to eight outside lines and up to eight MLX-82 interface units can be connected to a DIGITAL system. The MLX-82 DIP switches must be set to indicate the ordering of the outside lines. The MLX-82 is interface connected to the analog outside line card via an RS-232 interface. A maximum of two MLX-82 units can be chained together and connected to a single analog outside line card.

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix A
SYSTEM PROVISIONING

A.1 GENERAL

This appendix describes the provisioning requirements of the DIGITAL KEY BX system and DIGITAL 400 system hardware.

A.2 DIGITAL KEY BX SYSTEM PROVISIONING

Telephone sets and SLTs
Digital telephone sets are connected to ELD or EHD cards.

Analog telephone sets are connected to ELA cards.

SLTs (on-site or OPX) are connected to SLD and SHD cards.

On-site SLTs are connected to ONS and HONS cards.

Cards for telephone sets
Each ELD card can support either eight DAP or 16 SAP ports.

Each EHD card can support either four DAP or eight SAP ports.

The BRS card can support 4 S-bus ISDN interfaces, with one or two TE elements on each S-bus.

Each ELA card can support eight DAP or SAP ports.

Each SLD card can support up to eight SLTs.

Each SHD card can support up to four SLTs.

Each ONS card can support up to 16 on-site SLTs.

Each HONS card can support up to eight on-site SLTs.

Outside lines
Analog outside lines can be connected to the MPD386, DID, EMD, COG, COL and CHL cards.

The system can support a maximum of 48 outside lines -- including DID and EMD ports. Note that each DID and EMD port must be counted as both a power port (see Power port limitations below) and an outside line, regarding system capacity.

Each DID card supports eight analog Direct Inward Dialing ports.

The MPD386 -- which must be used in the DIGITAL KEY BX system -- can support four analog loop start outside lines.

Each COG card can support eight analog outside lines. This includes either eight ground start outside lines, eight loop start outside lines, or a combination of ground start and loop start outside lines totaling eight.

Each COL card can support eight analog loop start outside lines.

Each CHL card can support four analog loop start outside lines.

Each EMD card interfaces with up to four E&M (two or four-wire) analog PBX tie lines.

ISDN outside lines can be connected to a PRI24, PRI30, BR, or BHT card.

Each PRI24 card interfaces with up to 24 digital ISDN outside line B-channels. A maximum of one PRI card can be installed in each system cabinet.

Each PRI30 card interfaces with up to 30 digital ISDN outside line B-channels. A maximum of one PRI card can be installed in each system cabinet.

Each BRT cardhas four S bus ISDN ports (eight digital ISDN outside line B channels.

Each BHT card has two S bus ISDN ports (four digital ISDN outside line B-channels).

Each E1 card interfaces with one E1 carrier with a capacity of 30 PCM channels. This is the equivalent of 30 digital outside lines. Each E1 card can support any combination of DDI, DOD and E&M lines.

Each T1 card interfaces with one T1 carrier with a capacity of 24 PCM channels. This is the equivalent of 24 digital outside lines. Each T1 card can support any combination of analog loop, ground, DID and E&M lines.

Cabinets
You can connect up to three cabinets in the system.

Extension port limitations
A maximum of 96 extension ports can be supported by the system and a maximum of 32 extension ports by a system cabinet.

Extension ports include:

- Digital and analog sets;
- SLTs;
- modem module;
- MIM module voice ports -- if defined as IMAGEN ports;
- ISDN BRS ports;
- UDI card for CSD.

Any combination of DIGITAL system telephone sets and SLTs is permitted.

Power port limitations
A maximum of 32 power ports can be supported by a system cabinet.

Power ports include:

- Digital and analog sets;
- SLTs;
- EMD and DID analog card ports;
- The first 36-button Add-on unit connected to each digital set;
- ISDN BRS ports;
- UDI card for CSD.

Any combination of DIGITAL system telephone sets and SLTs is permitted.

Power supply
Each cabinet must contain a power supply unit. When a BBU is connected to the system, a special power supply unit is needed. It is installed in last system cabinets and contains the backup and control circuits, in addition to the normal facilities of the power supply.

It can be installed in the S-128 cabinet or hung on the wall near the cabinet. It provides about 90 minutes of backup under normal load, and about 20 minutes of backup under maximum load.

Battery pack time specification

Battery voltage	4 times 12 V/6.0 AH
Backup time for a three-cabinet system under nominal load	≤90 minutes
Backup time for a three-cabinet system under maximum load	≤20 minutes

Battery backup unit (BBU)
Two alternative BBU models are available:

- an internal BBU -- installed inside the system cabinet and providing 20 minutes of backup power under normal load;
- an external BBU -- wall mounted alongside the system cabinet and providing 90 minutes of backup power under normal load.

Uninterrupted power supply (UPS)

In the absence of a battery backup unit, the system cabinets can be connected to a suitably sized UPS (150 VA per system cabinet) supplied by the customer.

SLT ringer
Each of the SLD, ONS and HONS cards has arrangements for connection of a ringer, which is required if at least one SLT instrument is connected in the system. The SHD card has a built-in ringer.

Only one ringer is needed per system in a maximum configuration. This does not including an internal ringer on an SHD card.

Option card (OCD)
There can be up to three OCD cards in the system. Each OCD card can contain up to three option modules -- of the following module types:

- Multiple Interface module (MIM);
- Modem module supporting a baud rate of 2400 bps;
- DTMF module.

MIM module on the OCD card
Up to five MIM modules can be connected to the system.

A maximum of three MIM modules can be used for connecting IMAGEN.

A maximum of two MIM modules can be used for connecting external equipment.

DTMF module on the OCD card
There can be up to 17 DTMF receivers in the system. The permissible number of DTMF modules installed on the OCD card (with four DTMF receivers each) depends on the number of SLD and DID cards in the system. This limitation is determined by the location of other DTMF receivers, as follows:

- one on the MPD card;
- two on each , SLD, SHD, ONS and HONS card.
- In a system without DTMF modules or ONS/HONS, there can be up to 9 DTMF receivers.

Modem module
There can be only one modem module in the system which supports a baud rate of 2400 bps.

A.3 DIGITAL 400 SYSTEM PROVISIONING

Telephone sets and SLTs
Digital telephone sets are connected to ELD or EHD cards.

Analog telephone sets are connected to ELA cards.

SLTs (on-site or OPX) are connected to SLD and SHD cards.

On-site SLTs are connected to ONS and HONS cards.

Outside lines
Analog outside lines can be connected to the MPD386, DID, EMD, COG, COL and CHL cards.

ISDN outside lines can be connected to a PRI24 or PRI30, BRT or BHT card.

The system can support a maximum of 144 outside lines -- including DID and EMD ports. Note that each DID and EMD port must be counted as both a power port (see Power port limitations below) and an outside line, regarding system capacity.

MPD386 can be used in a single cabinet DIGITAL 400 system with up to 128 ports. It can support four analog loop start outside lines. The MPD-S400 card has no arrangement for outside lines.

Each COG card can support eight analog outside lines -- either eight ground start outside lines, eight loop start outside lines, or a combination of ground start and loop start outside lines totaling eight.

Each COL card can support eight analog loop start outside lines.

Each CHL card can support four analog loop start outside lines.

Each DID card supports eight analog Direct Inward Dialing lines.

Each T1 card interfaces with one T1 carrier, with a capacity of 24 PCM channels. This is the equivalent of 24 digital outside lines. Each T1 card can support any combination of analog loop ground, DID and E&M lines.

Each E1 card interfaces with one E1 carrier, with a capacity of 30 PCM channels. This is the equivalent of 30 digital outside lines. Each E1 card can support any combination of DID, DOD and E&M lines.

Each EMD card interfaces with up to four E&M analog PBX tie lines.

Each PRI24 card interfaces with up to 23 digital ISDN outside line B-channels. A maximum of four PRI24 cards can be installed in each system cabinet.

Each PRI30 card interfaces with up to 30 digital ISDN outside line B-channels. A maximum of four PRI30 cards can be installed in each system cabinet.

Each BRT cardhas four S bus ISDN ports (eight digital ISDN outside line B channels.

Each BHT card has two S bus ISDN ports (four digital ISDN outside line B-channels).

Cabinets

You can connect up to three cabinets in the system.

Extension port limitations
A maximum of 254 extension ports can be supported by the system and a maximum of 96 extension ports by a system cabinet.

Extension ports include:

- Digital and analog sets;
- SLTs;
- modem module;
- MIM module voice ports -- if defined as IMAGEN ports;
- ISDN BRS ports;
- UDI card for CSD.

Any combination of DIGITAL system telephone sets and SLTs is permitted.

Power port limitations
A maximum of 96 power ports can be supported by a system cabinet.

Power ports include:

- Digital and analog sets;
- SLTs;
- EMD and DID ports;
- The first 36-button Add-on unit connected to each digital set;
- ISDN BRS ports;
- UDI card for CSD.

Any combination of DIGITAL system telephone sets and SLTs is permitted.

Power supply
Each cabinet must contain a power supply unit.

Battery backup unit (BBU)
The two-hole -48 Vdc connector on the front panel of the DIGITAL 400 power supply can be used to connect a customer supplied BBU to the system.

Uninterrupted power supply (UPS)
In the absence of a battery backup unit, the system cabinets can be connected to a suitably sized UPS (500 VA per system cabinet) supplied by the customer.

SLT ringer
Each of the SLD, SHD, ONS, and HONS cards has arrangements for connection of a ringer, which is required if at least one SLT instrument is connected in the cabinet. The SHD card has a built-in ringer.

Only one ringer is needed per system cabinet in a maximum configuration (96 SLTs).

Option card (OCD)
There can be up to ten OCD cards in the system. Each OCD card can contain up to three option modules -- of the following module types:

- Multiple Interface module;
- Modem module supporting a baud rate of 2400 bps;
- DTMF module.

MIM module -- on OCD card
Up to 12 MIM modules can be connected to the system.

A maximum of four MIM modules can be used for connecting the IMAGEN.

DTMF module -- on OCD card
In a system without ONS or HONS cards, there can be up to 17 DTMF receivers comprised of 4 DTMF modules and 1 receiver on the MPD.

In a system with ONS, cards, there can be up to 37 DTMF receivers.

The permissible number of DTMF modules to be installed on the OCD card (with four DTMF receivers each) depends on the number of SLD, SHD, ONS, HONS and DID cards in the system and the use of DTMF receivers on those cards. This limitation is determined by the location of other DTMF receivers, as follows:

- one on the MPD card;
- two on each SLD, SHD, ONS and HONS card.

Modem module
There can be only one modem module in the system, which supports a baud rate of 2400 bps.

Table A-1 below defines the types of ports that must be included in the calculation of each of the limitations listed in Table A-2.

Table A-1 Port type definitions

Extension ports	Power ports	Outside lines
Extension ports include: • extensions of all types -- connected to the following types of cards: ◆ ELD ◆ EHD ◆ ELA ◆ SHD ◆ SLD ◆ HONS ◆ ONS ◆ BRS • ISDN data communications PC connected to BRS card; • internal modem; • IMAGEN ports; • Universal data interface (UDI) card for CSD.	Power ports include: • extensions of all types -- connected to the following types of cards: ◆ ELD ◆ SHD ◆ EHD ◆ ONS ◆ ELA ◆ HONS ◆ SLD • ISDN data communications PC connected to BRS card; • first add-on unit connected to a digital telephone set; • all connected analog DID and EMD card ports; • Universal data interface (UDI) card for CSD.	Outside lines include: • all connected ports on the following types of cards: ◆ MPD 386 ◆ COL ◆ COG ◆ T1/E1 ◆ CHL ◆ DID ◆ EMD ◆ PRI24 ◆ BHT ◆ PRI30 ◆ BRT

Maximum port limitations

The programming restrictions on the number of peripheral card ports of which can be connected to a DIGITAL system is summarized in Table A-2 below.

Table A-2 Maximum port limitations

System	maximum total ports	maximum outside lines	maximum extension ports		maximum power ports	
	per system	per system	per cabinet	per system	per cabinet	per system
DIGITAL KEY BX	128	48	32	96	32	96
DIGITAL 400	384	144	96	254	96	288

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix B
TECHNICAL SPECIFICATIONS

B.1 GENERAL

This appendix contains technical specifications of the DIGITAL KEY BX and DIGITAL 400 systems. It includes parameters relating to both physical and to electrical characteristics.

The parameters stated below are typical at 77° F, unless otherwise noted.

Where differences occur between DIGITAL KEY BX and DIGITAL 400, they are detailed below. Where not otherwise stated, it can be assumed that the characteristics and features of the two systems are identical.

B.2 SYSTEM SPECIFICATIONS

B.2.1 Card slots

	DIGITAL KEY BX	DIGITAL 400
One cabinet	6	15
Two cabinets	12	30
Three cabinet	18	45

B.2.2 Circuits per card

	DIGITAL SYSTEMS
PRI24 ISDN outside line card	23 B + 1D channels
PRI30 ISDN outside line card	30B + 1D channels
COL Central Office Loop-start outside line card	8
CHL Central Office Loop-start outside line card	4
COG Central Office Ground-start outside line card	8
DID (Direct Inward Dialing card)	8
EMD (E&M tie line card)	4 two-wire ports or 2 four-wire ports
T1 digital outside line card	24 channels
E1 PCM-30 digital outside line card	30 channels
ELD and EHD Executive Line Digital telephone cards:	
With eight S-buses (ELD):	
Single audio path telephone sets	16
or	
Dual audio path telephone sets	8
With four S-buses (EHD):	
Single audio path telephone sets	8
or	
Dual audio path telephone sets	4
ELA Executive Line analog telephone cards	8
SLD Single Line Telephone card	8
SHD Single Line Telephone card	4
ONS On-site Single Line Telephone card	16
HONS On-site Single Line Telephone card	8
BRS Subscriber Line Termination mode card	4

B.2.3 Card and module parameters

	DIGITAL KEY BX	DIGITAL 400
Maximum Main Processing (MPD) cards	1	1
Maximum Digital Phase Locked Loop module (used on MPD386 only)	1	1
Maximum COL outside line cards	6	18
Maximum CHL outside line cards	12	36
Maximum COG outside line cards	6	18
Maximum DID outside line cards	6	18
Maximum EMD tie line cards	12	36
Maximum PRI24 ISDN digital outside line cards	1 per cabinet (two per system)	4 per cabinet (12 per system)
Maximum PRI30 ISDN digital outside line cards	1 per cabinet	4 per cabinet
Maximum BRS Subscriber Line Termination mode cards	17	44
Maximum BRT Subscriber Line Termination mode cards	6	18
Maximum T1 digital outside line cards	2	6
Maximum E1 digital outside line cards	2	5 only if fully configured
Maximum ELD digital telephone cards	12	32
Maximum EHD digital telephone cards	17	44
Maximum ELA analog telephone cards	12	6 Per Cabinet, 15 per system
Maximum SLD SLT cards	12	32
Maximum SHD SLT cards	17	44
Maximum ONS on-site SLT cards	6	16
Maximum HONS on-site SLT cards	12	32

Maximum DTMF receiver modules	4	4
Maximum modem modules	1	1
Maximum multiple interface modules (MIM)	5	12
Maximum Option (OCD) cards	3	10
Maximum option modules	9	30
Minimum small auxiliary (SAX) motherboards (required for a two- or three-cabinet system)	0	1
Maximum small auxiliary (SAX) motherboards (per cabinet)	0	1

B.2.4 Extensions, IMAGEN voice mail channels and Add-on units supported by the system

	DIGITAL KEY BX	DIGITAL 400
Maximum ports	128	384
Maximum total of outside lines, extensions and IMAGEN voice mail channels	128	384
Maximum outside lines -- analog and digital -- connected to MPD386 COL, CHL, COG, T1/E1, PRI24, PRI30, BRT, BHT, DID and EMD cards	48	144
Maximum extension ports (including: extensions of all types connected to ELD, EHD, ELA, SLD, SHD, ONS and HONS, cards, IMAGEN channels, internal modem, ISDN BRS ports, UDI card for CSD)	96	254
Maximum power ports (including extensions of all types and the first add-on unit per telephone set, EMD and DID ports, ISDN BRS ports, UDI card for CSD)	96	288
Maximum power ports per system cabinet	32	96
Maximum extension maps	43	49
Maximum number of 36 button Add-on units in the system	8	16
Maximum number of 36 button Add-on units per telephone set	4	4

Maximum IMAGEN voice mail channels	12	16
Maximum 36 button Add-on unit maps	4	8

B.2.5 Extensions, outside lines, IMAGEN channels and Add-on units supported per system cabinet

	DIGITAL KEY BX	DIGITAL 400
Maximum extension ports extension ports include: extensions of all types connected to ELD, EHD, ELA, SLD, SHD, ONS and HONS, cards, IMAGEN voice mail channels, internal modem, ISDN, BRS ports, UDI card for CSD)	32 per cabinet	96 per cabinet

B.2.6 Music interface

The Main Processing card (MPD) supports the following music options:	
Maximum voice channels on MPD card for MOH and BGM	2
Background music source input ports (external music source)	1
Music-on-hold internal synthesizer	1

B.2.7 DTMF receivers

	DIGITAL KEY BX	DIGITAL 400
DTMF receivers per MPD card	1	1
DTMF receivers per DID card	2	2
DTMF receivers per SLD card	2	2
DTMF receivers per SHD card	2	2
DTMF receivers per ONS card	2	2
DTMF receivers per HONS card	2	2
DTMF receivers per DTMF module 4	4	4
Maximum number of DTMF modules	4	9
Maximum number of DTMF receivers	17	37

B.2.8 IMAGEN Integrated Voice Mail

	DIGITAL KEY BX	DIGITAL 400
Maximum number of personal computers for IMAGEN	1	1
Number of IMAGEN voice mail ports	2, 4, 6, 8, 10 or 12	2, 4, 6, 8,10,12, 14 or 16

B.2.9 External paging, door units and external bells

	DIGITAL KEY BX	DIGITAL 400
Maximum number of external door units and external page zones	8	8
Maximum number of external bells	4	4
Maximum voice channels on MPD card (for MOH and BGM)	2	2
Maximum voice channels per system	4	8
Maximum voice channels on OCD card	12	12
Maximum number of relays	13	24
Maximum number of sensors	14	12

B.2.10 Switching parameters

Distribution Time Division Multiplexing (TDM)

Pulse Code Modulation (PCM)

A-law method

B.2.11 Traffic

The systems are totally non-blocking.

	DIGITAL KEY BX	DIGITAL 400
Outside line calls unblocked	48	144
Internal handset calls unblocked	48	144
Simultaneous DISA calls	4	4
Simultaneous conference calls	10	10
Maximum simultaneous conference call participants	30	30
Meet me conference (optional)	30	30
Intercom loop conference	30	30
Station Message Detail Recording (SMDR) outside line call records stored (buffered)	144	250
Maximum two-way simultaneous conversations	64	192

B.2.12 Extensions supported

DIGITAL system digital telephone sets (four wire)

DIGITAL system analog electronic telephone sets (four and six wire), Executive station, Standard Display station, Basic Key Set and Four Button Plus station

DTMF or impulse SLT extensions (type 500 or 2500).

Table B-1 shows the number of DTMF receivers required to support regular or heavy traffic based on the number of DTMF ports in the DIGITAL system.

Table B-1 DTMF Requirements

Ports requiring DTMF receivers (SLT/DID)	Regular Traffic (3.6 CCS)	Heavy Traffic (9 CCS)
8	3	3
16	3	3
24	3	5
48	5	5
56	5	5
64	5	7
96	5	7
104	5	9
120	5	9
136	5	9
144	7	9
152	7	11
160	7	11
168	7	11
200	7	11
208	7	13
216	7	13
224	7	13
254	7	13

B.2.13 Cabinet dimensions

	DIGITAL KEY BX		DIGITAL 400	
	cm	in.	cm	in.
Single cabinet			**(without base)**	
Height	52	20.5	43	16.9
Width	20	7.9	63	24.8
Depth	35	13.8	38	15.0
Double cabinet			**(without base)**	
Height	52	20.5	86	33.9
Width	40	15.7	63	24.8
Depth	35	13.8	38	15.0

Triple cabinet -- plus base	DIGITAL 400	
Height	138	54.3
Width	63	24.8
Depth	66	26.0

B.2.14 Cabinet weight

	DIGITAL KEY BX		DIGITAL 400	
	kg	**lb.**	**kg**	**lb.**
One empty cabinet	5	11	12.5	27.5
One fully loaded cabinet	18	40	27	59.4
Full system	55	121	84	184.8

B.2.15 Power supply

	DIGITAL KEY BX	DIGITAL 400
Maximum input power:		
One cabinet	150 VA	500 VA
Two cabinets	300 VA	1000 VA
Three cabinets	450 VA	1500 VA
Input voltage	110 VAC	120 VAC
Frequency	50/60 Hz	50Hz

B.2.16 Personal computer port parameters

Functions supported	System administration and maintenance
Type	RS-232, serial, asynchronous with break character generation
Number of personal computers for administration and maintenance	1
Baud rate (Default 4800)	300, 600, 1200, 2400 or 4800
Parity	None
Stop bits	1, 1.5, 2
Start bits	False start bit detection
Data bits	5 to 8
Loop length (24 AWG wire)	50 feet (16 m)

B.2.17 Printer port parameters

Number of printers for maintenance and Station Message Detail Recording (SMDR)	1
Baud rate:	
on OCD card (Default 4800)	300, 600, 1200, 2400, 4800 or 9600
on outside line card (Default 4800)	300, 600, 1200, 2400, or 4800
Record length	80 characters

B.2.18 Modem

Communications	Hayes protocol, Bell 212A, CCITTv.21, v.22, v.22.bis
Baud rate	2400 bps
Error detection and correction	MNP 2-4, v42
Compression	MNP 5, v42.bis
Analog/digital and remote digital loop back	
Call progress mode	
DTMF dialing	

B.2.19 DIGITAL system digital telephone set parameters

The DIGITAL system digital telephone set dimensions and weight are listed in Table B-2, below.

Table B-2 Digital telephone set dimensions and weights

Telephone set model	Height (in.)	Length (in.)	Width (in.)	Weight (lb.)
4 Button, 16 Button, Display Speakerphone and Speakerphone sets	1.9	8.9	6.3	1.9
Executive set	1.9	8.9	8.9	2.4
36 button	1.9	8.9	3.3	0.8
Display Speakerphone set with one Add-on unit	1.9	8.9	9.6	2.7
Executive set with one Add-on unit	1.9	8.9	12.2	3.2
Executive set with two Add-on units	1.9	8.9	15.6	4.0
Executive set with three Add-on units	1.9	8.9	18.9	4.8
Executive set with four Add-on units	1.9	8.9	22.2	5.6

B.2.20 Telrad Tracker parameters

The Telrad Tracker handset and base unit dimensions follow:

Frequency control	Phase Locked Loop
Modulation	FM
Operating temperature	-10° C to 50° C (14° F to 122° F)
Receive and transmit frequency	902 MHz to 928 MHz
Power requirements base unit	10 Vdc
Power requirements handset	Rechargeable sealed lead acid battery
Battery capacity	500 mAh, 4.0 V
Operating time -- talk mode	5 hours (typical)
Operating time -- standby mode	40 hours (typical)

B.2.21 Telrad Tracker set dimensions and weight

Telrad Tracker	Height (in)	Depth (in)	Width (in)	Weight (lb)
Handset with antenna	8.50	1.50	2.25	0.55
Base unit	2.25	7.50	4.25	0.96

B.2.22 DIGITAL system analog telephone set parameters

The DIGITAL system analog telephone set dimensions and weight are listed in Table B-3, below.

Table B-3 Analog telephone set dimensions and weights

Telephone set model	Height (in.)	Length (in.)	Width (in.)	Weight (lb.)
Executive station	3.1	9.0	9.4	2.8
Standard Display station	3.1	9.0	9.4	2.7
Basic Key Set	3.1	9.0	9.4	2.7
Four Button Plus	3.1	9.0	7.1	2.1

B.2.23 T1 digital outside line interface

T1 interface connection to Central Office	Via a Channel Service Unit (CSU)
T1 interface connection to local networked DIGITAL system	CSU
Types of T1 interface operating modes	Superframe (SF) or Extended Superframe (ESF)
Types of T1 interface synchronization statuses	Free running Primary or Secondary

B.2.24 E1 PCM-30 digital outside line interface

PCM-30 interface connection to Central Office	Directly
PCM-30 interface connection to local networked system	Directly
Types of PCM-30 interface synchronization statuses	Free running Primary or Secondary

B.2.25 ISDN PRI24/PRI30 interface

ISDN PRI24/PRI30 interface connection to Central Office	CSU

B.2.26 BRT BHT interface

BRT BHT interface	NT-1

B.3 FUNCTIONAL PARAMETERS

B.3.1 Outside line, pickup, DID, hunt, map and ring route groups

	DIGITAL KEY BX	DIGITAL 400
Maximum number of outside line groups	10	32
Maximum number of outside lines per outside line group	48	144
Maximum extensions in pickup group	32	32
Maximum Direct Inward Dialing (DID) groups	10	32
Maximum DID routes	200	400
Maximum simultaneous call forwards	128	384
Maximum hunt groups	16	32
Maximum extensions per hunt group	32	32
Slave MDNs	250	349
Maximum number of MDN groups	250	400
Maximum members per MDN group	16	16
Maximum extensions in day/night ring for private outside lines	16	16
Maximum extensions in day/night ring for group outside lines	16	16
Maximum DISA authorization codes	96	254
Digits in DISA authorization code	4	4

B.3.2 Classes of Service

	DIGITAL KEY BX	DIGITAL 400
Maximum classes of service	64	64
Maximum global classes of service	5	5

B.3.3 Directory numbers

	DIGITAL KEY BX	DIGITAL 400
Maximum Directory Numbers (DNs)	256	1024
Maximum digits in DNs	4	4

B.3.4 Multiple Directory numbers

	DIGITAL KEY BX	DIGITAL 400
Maximum multiple directory number (MDN) map groups	250	400
Maximum MDNs per map group	16	16
Maximum MDN members in the system	256	512

B.3.5 Executive Intercom

	DIGITAL KEY BX	DIGITAL 400
Maximum extensions accessed by one executive intercom (manager/secretary)	95	254
Maximum executive intercom (manager/secretary) definitions	380	380
Maximum multimanagers	16	32

B.3.6 Automatic dialing

	DIGITAL KEY BX	DIGITAL 400
Maximum digits in a personal (extension) speed dial bin	16	16
Maximum personal (extension) speed dial numbers	89	89
Digits in personal (extension) speed dial code	2	2
Maximum speed dial arrays	2	2
Maximum personal and system speed dial numbers per array	1700	2700
Maximum system speed dial groups per array	10	10
Digits in system speed dial code	2 or 3	2 or 3
Maximum digits in a system speed dial bin	16	16
Maximum simultaneous redials (number of stations)	96	96
Maximum digits in redial buffer	32	32
Maximum simultaneous extension or outside line callbacks (per extension)	1	1
Maximum digits in a personal (extension) speed dial bin	16	16
Maximum personal (extension) speed dial numbers	89	89
Digits in personal (extension) speed dial code	2	2

B.3.7 Least Cost Routing (LCR)

	DIGITAL SYSTEMS
Maximum LCR route table definitions	32
Maximum preceding digits to add in LCR	24
Maximum trailing digits to add in LCR	22
Maximum digits to delete in LCR	32
Maximum route steps per LCR route table	5
Maximum time of day LCR routing schedules	3
Maximum LCR modification tables	50
Maximum LCR area routes	220

Maximum LCR overseas routes	50
Maximum LCR office codes	1000
Maximum LCR public network routes	20
Maximum ISDN Call By Call service tables	1
Maximum ISDN Call By Call service table codes	30

B.3.8 Toll Restriction

	DIGITAL SYSTEMS
Maximum toll restriction groups (allowed/denied)	32
Maximum toll restriction entries	270
Maximum digits per toll restriction number	31

B.3.9 Networking

	DIGITAL SYSTEMS
Maximum prefixes	49
Maximum DID prefixes	32
Maximum dialed number translation tables	32
Maximum numbers on dialed number translation tables	256

B.3.10 Paging

	DIGITAL SYSTEMS	
Maximum routed extensions per page zone		100
Maximum internal page zones		8
Maximum external page zones per MIM module		4
Maximum external page zones in system	8	8

B.3.11 Automatic Call Distribution (ACD) configurations

NOTE

Automatic Call Distribution (ACD) is a separate optional software package and is not part of the basic system package.

	DIGITAL KEY BX	DIGITAL 400
Maximum number of ACD groups	16	24
Maximum number of agents	160	300
Maximum agents per ACD group	64	64
Maximum number of ACD plans	32	48
Maximum length of group name	7	7
Maximum length of agent name	7	7
Maximum length of plan name	16	16
Maximum length of supervisor name	7	7
Maximum number of supervisors	8	16
Maximum SLT announcers	4	8
Maximum ACD announcer plans	16	24
Maximum ACD announcements on IMAGEN	50	50

B.3.12 Attendant Console (ATC) parameters

	DIGITAL SYSTEMS
Maximum ATCs	4
Maximum system queues	56

B.3.13 DIGITAL system digital telephone sets

	DIGITAL SYSTEMS
Loop resistance	90 ohms (4 wire)
Power output per telephone set	4 W
Maximum loop length	2970 feet (891 meters)

B.3.14 DIGITAL system analog telephone sets

	DIGITAL SYSTEMS
Loop resistance	72 ohms (4 wire)
Power output per telephone set	2 W
Maximum loop length	2400 feet (800 meters)

B.3.15 Single line telephone (SLT) parameters

	DIGITAL SYSTEMS
Type	500 or 2500
Loop resistance	0 to 1800 ohms
SLD and SHD	0 to 1200 ohms
ONS and HONS	
Loop length	3.6 miles
SLD and SHD	3.0 miles
ONS and HONS	

B.3.16 SLT ringer parameters

	DIGITAL KEY BX	DIGITAL 400
Frequency	20	20
Amplitude	75-95 VAC	75-95 VAC
Power output	15-20 W	15-20 W
Maximum simultaneously ringing SLTs	96	254
Maximum ringers per cabinet	1	1
Maximum ringers per system	1	3
Maximum ringers required		
Internal ringer -- connected to SLD, ONS or HONS card	1 per system	1 per cabinet
Internal ringer -- built-in on SHD card (only for SLTs connected to that card)	1 per card	1 per card
External ringer -- connected to power supply -- for system cabinets with SLD, ONS or HONS cards	1 per 96 SLTs	1 per 96 SLTs

B.3.17 DID card parameters

	DIGITAL SYSTEMS
Maximum loop length	3.75 Miles (6 km)
Resistance	1800 ohm

B.3.18 T-1 card parameters

	DIGITAL SYSTEMS
Distance from CSU	Programmable up to 1400 feet (420 meters)

B.3.19 E&M card parameters

	DIGITAL SYSTEMS
Maximum loop length	3.75 Miles (6 km)
Resistance	1800 ohm

B.3.20 ONS and HONS message lamp power supply parameters

	DIGITAL SYSTEMS
Voltage output	110 VDC
Power output to ONS or HONS card	10 W
External message lamp power supply	1 per cabinet
External power output of message lamp power supply	60 W

THIS PAGE INTENTIONALLY LEFT BLANK

76-110-0685/F
Release SB6/DB6
Issue 1

Printed in Israel

Telrad

Telrad Telecommunications Inc.
Woodbury, New York